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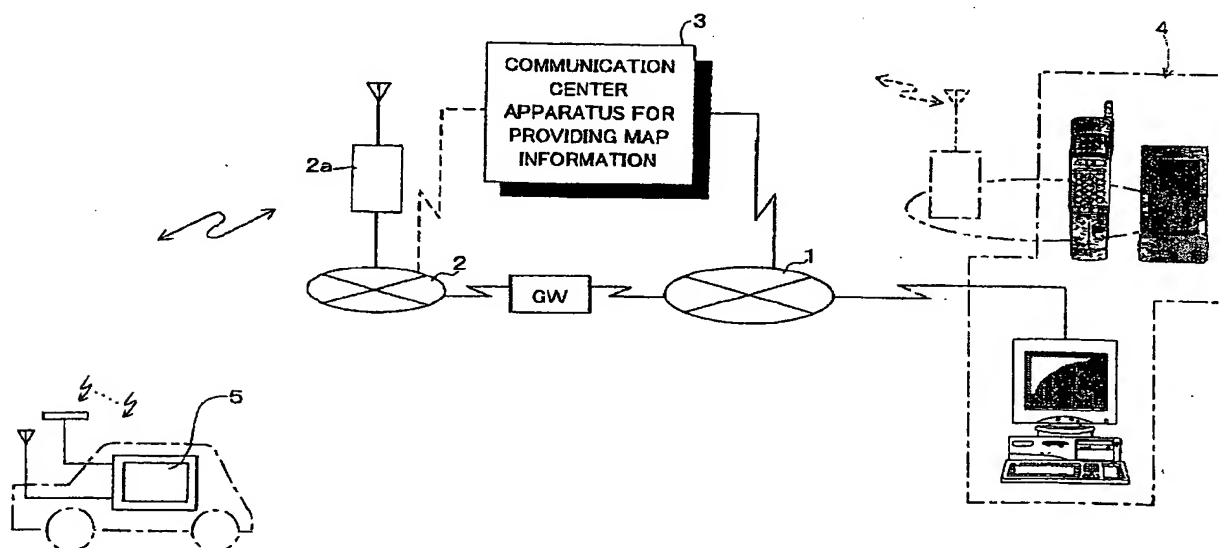
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(54) **Method and system of navigation with communication center for providing map information, terminal and computer program to perform communication navigation**

(57) A communication navigation system is provided with a communication center apparatus (3) and a communication navigation terminal (5), which perform two-way communication on a communication network (1, 2). The communication center apparatus for providing map information is provided with: a search device (74) for searching for a recommendation route with respect to the request of route search from the communication navigation terminal; and a wireless device (73)

for wirelessly transmitting guidance position information including information indicating a direction or a route to be advanced and/or information indicating a location of each one of a plurality of guidance positions located on the recommendation route. The communication navigation terminal is provided with a display processing device (43) for displaying the recommendation route by connecting the plurality of guidance positions by interpolation according to the content of the received guidance position information.



**FIG. 1**

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## Description

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

[0001] The present invention generally relates to a communication navigation system and method, which execute, at a communication navigation terminal mounted on a movable body such as a vehicle or the like, a navigation operation such as presentation of a recommendation route or the like by using map database information (hereunder, it is referred to as map D/B information as occasion demands) provided from a communication center apparatus for providing map information on a communication network. The present invention also relates to the communication center apparatus for providing map information, the communication navigation terminal and a computer program to perform communication navigation.

#### 2. Description of the Related Art

[0002] Generally speaking, a navigation apparatus mounted on a vehicle has a function called "route search" or "path search" and is designed to be capable of searching for a recommendation route (or an optimum route) connecting an origin and a destination, both of which are designated by a user. It is also designed to lead and guide (navigate) the user to the destination by displaying on a map a current position based on a self-contained or built-in positioning measurement or a GPS (Global Positioning System) measurement and the searched recommendation route.

[0003] With respect to a traditional navigation apparatus, this kind of route search is performed by microprocessor processing in the apparatus on the basis of the map D/B information stored in a map information recording medium (e.g. DVD-ROM) set in the navigation apparatus. More concretely, the route search is executed by using "information for route search", which enables a search for the recommendation route based on predetermined mathematical algorithm, such as link information corresponding to a road part between branching points and intersections, node information including coordinates information (absolute position information on latitude and longitude, or on altitude, latitude and longitude) corresponding to the branching points and the intersections of roads or the like among the map D/B information. Generally, in view of its nature of being for route search, this kind of information for route search is constructed by the link information, the node information, and the like, which are about broad areas where roads are mutually connected, for example, such as throughout Honshu or the main island of Japan, throughout Japan, or the like, so that its volume of data becomes enormous, which increases the whole amount of data of the map D/B information.

[0004] Moreover, the map D/B information includes data of added information, which is facility guidance information on tourist attractions / facilities, facility numerals, names (characters) of maps / roads, views of waters / railroads, and roads, in each one of many pieces of map information (drawings). These data as well as the above-described information for route search further increase the volume of data of the map D/B information.

[0005] By the way, the search for the recommendation route requires the newest map D/B information because of changes, new constructions, and the like on roads.

[0006] Therefore, there is a need to equip for the traditional navigation apparatus a map information recording medium that stores the map D/B information which is the newest and whose data volume is enormous. At the same time, there is a need of the display processing and the search processing of a recommendation route based on the complicating map D/B information. In this case, there is a need to mount a microprocessor unit (MPU), which is capable of high-speed processing, so that the scale of the processing and that of the apparatus come to increase.

[0007] On that account, various communication navigation systems are suggested in order to improve such increase of the scale of the processing and that of the apparatus. In these communication navigation systems, the map D/B information is obtained and provided through two-way wireless communication between a communication center apparatus for providing map information on a communication network and a communication navigation terminal mounted on a vehicle (e.g. refer to the examples of Japanese Patent Application Laying Open NO. Hei 7-262493 "a system for distributing map information for a movable body" and Japanese Patent Application Laying Open NO. Hei 10-96644 "a system for guiding a moving route").

[0008] In this type of the communication navigation system, the newest map D/B information can be provided all at once by updating the map D/B information at one communication center apparatus. By this type of the communication navigation system, the newest map D/B information can be provided quickly and cheaply, comparing the traditional navigation apparatus in which the newest map D/B information is provided for an individual navigation apparatus on a vehicle with the information recording medium, such as a DVD-ROM. Therefore, users side becomes able to easily receive the map D/B information including the newest information for route search or the like.

[0009] However, the above-described communication navigation system has the following disadvantage (1) to (4):

- (1) In the case that radio or wireless transmission is performed from the communication center apparatus for providing map information to the communication navigation terminal, the map D/B information including the information for route search or the

like, whose data volume is enormous, is wirelessly transmitted. Especially depending on a range of an origin and a destination of route search request, its data volume increase, because the route search is executed with respect to a plurality of map information (drawings). Therefore, traffic volume in a wireless section increases, and it becomes difficult to access a circuit. On that account, it becomes necessary to transmit repeatedly to access the circuit from the communication navigation terminal, which generates convergence at the communication center apparatus for providing map information, and further this makes it more difficult to access the circuit.

(2) To solve this problem, it is possible to consider installing a plurality of communication center apparatuses for providing map information on the communication network. In that case, however, the cost for administering operations may increase on the side of administrators that provide the map D/B information and the like.

(3) Moreover, if a radio transmission rate is more speeded up to solve the problem, the scales of data processing and those of apparatus of the communication navigation terminal and the communication center apparatus for providing map information will become large, which will cause the cost of each apparatus to increase.

(4) As for a communication navigation terminal mounted on a vehicle, the communication navigation terminal performs route search processing by own microprocessor. As the route search processing has many processing steps, this causes heavy load of processing in the microprocessor. Furthermore, in recent years, the navigation apparatus tends to unification with a television apparatus, an audio apparatus, and the like (i.e. multifunctionalization). The load in the microprocessor is further increased. This makes processing of the microprocessor difficult in the communication navigation terminals.

**[0010]** On the other hand, it is also considered that the route search is performed on the side of the communication center apparatus for providing map information. In this case, however, the necessity to wirelessly transmit arises after generating the map information, which is specially designed to include the searched recommendation route in a thick line or the like, so that the volume of data to be wirelessly transmitted will become enormous. In addition, there arises a need to wirelessly transmit information for outputting as voice or sound or for outputting as image route guidance or the like (hereunder, the information is referred to as route guidance information as occasion demands), such as instructions of left turn, right turn, or straight advance and the like at each guidance position such as a turning point, a branching point, an intersection, or the like on the searched recommendation route, so that the volume of

data to be wirelessly transmitted will become further enormous.

**[0011]** For this problem, there is suggested a communication navigation system for performing distributed processing of the route search on the sides of the communication navigation terminal and the communication center apparatus for providing map information (e.g. refer to Japanese Patent Application Laying Open NO. Hei 10-300500 "apparatus for route search"). However, according to this system, each route data which becomes a candidate, their required time length (cost), and the like are transmitted from the side of the communication center apparatus for providing map information, and the route search is performed on the side of the communication navigation terminal on the basis of them, so that all of the processing become complicated and it needs complex transmission and reception of the considerable volume of data, which is a problem.

## 20 SUMMARY OF THE INVENTION

**[0012]** It is therefore an object of the present invention to provide a communication navigation system and a communication navigation method, which enable presentation of a recommendation route at the communication navigation terminal, while restraining increase of the scale of processing or the scale of an apparatus at the communication navigation terminal and decreasing the volume of data transmitted or received between the communication center apparatus for providing map information and the communication navigation terminal, as well as the communication center apparatus for providing map information, the communication navigation terminal, and a computer program which allows a computer to function as such a communication navigation system.

**[0013]** The above object of the present invention can be achieved by a communication navigation system comprising: a communication center apparatus; and a communication navigation terminal, which perform two-way communication on a communication network, (i) the communication center apparatus comprising: a map database for storing therein map database information including information for route search, which enables a search for a recommendation route from an origin to a destination; a search device for searching for the recommendation route with respect to route search request information that indicates the origin and the destination and that is received through the communication network, on the basis of the information for route search; and a center side communication device for wirelessly transmitting, through the communication network, guidance position information including at least any one of information indicating a location of each one of a plurality of guidance positions located on the searched recommendation route, information indicating a direction to be advanced at each one of the plurality of guidance positions and information indicating a route to be ad-

vanced at each one of the plurality of guidance positions, and (ii) the communication navigation terminal comprising: a terminal side communication device for receiving the guidance position information wirelessly transmitted; and a display processing device for displaying a route, which is obtained by connecting the plurality of guidance positions on a map shown with map information for display according to the contents of the received guidance position information, as the recommendation route on the map.

**[0014]** According to the communication navigation system of the present invention, the communication center apparatus is provided with the map database. This map database stores the large-scale map database information including the information for route search such as the above-described node information, link information, or the like, which enables a search for the recommendation route from an origin to a destination, for example, by predetermined mathematical algorithm such as Dijkstra's algorithm and so on. When communication navigation is performed, the route search request information indicating an origin and a destination is firstly transmitted by a user communication terminal, such as a cellular phone, a mobile, a facsimile, a personal computer, or the like, at a user's home, a communication navigation terminal, which is carried by a user or which is mounted on a user's movable body, and so on. Secondly, the communication center apparatus receives this information through the communication network. Then, at the communication center apparatus, the search device searches for the recommendation route with respect to the received route search request information on the basis of the information for route search included in the above-described map database information. Then, the center side communication device wirelessly transmits, through the communication network, guidance position information including at least any one of information indicating a location of each one of a plurality of guidance positions located on the searched recommendation route, information indicating a direction to be advanced at each one of the plurality of guidance positions and information indicating a route to be advanced at each one of the plurality of guidance positions. In this specification, the "guidance position" is referred to a position which has a plurality of choices about the way to drive such as a stopping position, a branching position, an intersection, or the like and at which it is preferable to perform route leading or route guidance of some kind in order to drive on a predetermined route. The guidance position may include a specific position such as a bridge, a tunnel, a crossing with an overpass or a underpass, U-turn area, a turning corner, or the like in addition to a position at which there are two or more accessible routes on the recommendation route, such as an interchange, a branching point, an intersection, or the like. Moreover, it may include various positions that have possibility of starting or stopping the use of roads by a movable body such as a residential parking lot, a

building parking lot or the like, an exclusive parking lot, in front of one's home, at stores, an on-street parking area, or the like. Moreover, the "information indicating a location of each one of a plurality of guidance positions" is information that allows specification of a location of each guidance position somehow on a map shown with the map information for display, such as coordinates information that indicates absolute locations on guidance positions, coordinates information that indicates relative locations with the absolute location as a standard, information that specifies guidance positions with specific roads considered, information that indicates one-dimensional locations on specific roads. Furthermore, the "information indicating a direction or a route to be advanced at each one of the plurality of the guidance positions" is information indicating a direction or a route to be advanced such as left turn, right turn, straight advance, or the like at each guidance position. It may be information indicating relationship of locations or a relative direction with reference to a road on which a movable body or the like is advancing or information indicating an absolute azimuth of a direction to be advanced. Incidentally, the "information indicating a direction or a route to be advanced" may include route guidance information indicating a route to be advanced by audio output or by display output at a guidance position or just before reaching it.

**[0015]** On the side of the communication navigation terminal, the terminal side communication device receives the guidance position information that is wirelessly transmitted from the communication center apparatus. Then, the display processing device displays a route, which is obtained by connecting the plurality of guidance positions according to the contents of the received guidance position information (i.e. a location of each guidance position, and a direction or a route to be advanced at each guidance position), as the recommendation route on the map. For example, if there is a guidance position corresponding to two adjacent intersections on one winding national road, the part of national road between these intersections is chosen as the recommendation route. Alternatively, if there is a guidance position corresponding to two interchanges on an expressway, the part of expressway between these interchanges is chosen as the recommendation route. For example, it is possible to connect a plurality of guidance positions according to the contents of guidance information by interpolating some parts, which are located between the plurality of guidance positions, on a road map or a map for display, so that the recommendation route can be obtained. Namely, "to connect a plurality of guidance positions according to the contents of guidance information" in the present invention includes not only its literal meaning of simply connecting a plurality of guidance positions on a road map or a map for display, but also a meaning of connecting each one of a plurality of guidance positions while interpolating them on a map road or a map for display. In short, the purpose is that a

route including the plurality of guidance positions may be chosen or specified somehow according to the contents of guidance position information associated with the plurality of guidance positions. In this case, the map information for display, which will be used, may be read out from a storing device such as a DVD or the like provided for the communication navigation terminal. Alternatively, it may be transmitted in advance or with the guidance position information at the same time from the communication center apparatus. In this case again, as for the map information for display, it is possible to plan to decrease its data volume to be transmitted and received as long as it is transmitted separately from the map database information including the information for route search, whose data volume is enormous as described above.

**[0016]** As described above, in the communication navigation system of the present invention, there is hardly any need to wirelessly transmit through the communication network the information for route search, whose data volume is enormous as described above, or the map database information including this. Moreover, there is hardly any need to newly generate map information, in which the searched recommendation route is described in boldface type or the like, to wirelessly transmit it through the communication network. In addition, it is possible to perform the transmission and the reception of the guidance position information more easily than those on the above-described distribution processing.

**[0017]** Accordingly, it is possible to decrease the volume of data, which are transmitted and received between the communication center apparatus and the communication navigation terminal, as well as presenting the recommendation route at the communication navigation terminal while restraining increase of the scale of the processing at the communication navigation terminal and the scale of the construction of the communication navigation terminal.

**[0018]** Therefore, it is possible to effectively avoid the situation that the volume of traffic between wireless sections increases and that it becomes difficult to access circuits, so that one or a few communication center apparatuses can deal with the processes for many communication navigation terminals. Consequently, communication navigation companies can hold down the cost of operation administration. Moreover, since it is not necessary to speed up a wireless transmission, the machine performance of the communication navigation terminal and that of the communication center apparatus are relatively low, so that it is possible to plan low cost of the whole system. In addition, as for the communication navigation terminal, it is possible to plan low cost, considering that the processing capacity of a processor can be distributed into more functions such as a television function, an audio function, and the like because of reduction of load of processing on a navigation operation including the relevant communication operation or

the like.

**[0019]** In one aspect of the communication navigation terminal of the present invention, the terminal side communication device transmits the route search request information and the center side communication device receives the route search request information.

**[0020]** According to this aspect, the terminal side communication device provided for the communication navigation terminal carried by the user or mounted on the user's movable body firstly transmits the route search request information and the center side communication device secondly receives this route search request information. Then, the recommendation route is searched for on the basis of this, so that it becomes possible to present the recommendation route at the communication navigation terminal, while decreasing the volume of data, which are transmitted and received on the communication network, when the user actually starts moving or while moving.

**[0021]** In another aspect of the communication navigation terminal of the present invention, it is further provided with a user communication terminal, which performs two-way communication on the communication network and which transmits the route search request information.

**[0022]** According to this aspect, the user communication terminal such as a cellular phone, a mobile, a facsimile, a personal computer, or the like installed at the user's home firstly transmits the route search request information and the center side communication device secondly receives this route search request information. Then, the recommendation route is searched for on the basis of this, so that it becomes possible to request the recommendation route before the user actually starts moving, and later it becomes possible to present the recommendation route at the communication navigation terminal when the user actually starts moving and while moving.

**[0023]** In another aspect of the communication navigation terminal of the present invention, if the searched recommendation route includes an expressway, the plurality of guidance positions include at least one of a parking area, a service area, and an interchange on the expressway.

**[0024]** According to this aspect, if all of or one portion of the recommendation route is an expressway, the guidance position information associated with a service area, and an interchange on the expressway or the guidance position information associated with a parking area is transmitted and received. Therefore, it is possible to specify the recommendation route relatively easily by the display processing device on the basis of the guidance position information in this kind while decreasing the volume of data, which are transmitted and received on the communication network.

**[0025]** In another aspect of the communication navigation terminal of the present invention, the center side communication device thins out the plurality of guidance

positions according to the type of the searched recommendation route, and transmits the guidance position information with respect to each one of the thinned guidance positions.

**[0026]** According to this aspect, the center side communication device transmits the guidance position information on each one of the plurality of guidance positions after thinning out the plurality of guidance positions located on the recommendation route according to the type of the searched the recommendation route such as a national road, an expressway, or the like, so that it is possible to further decrease the volume of data, which are transmitted and received on the communication network.

**[0027]** In another aspect of the communication navigation terminal of the present invention, the center side communication device thins out the plurality of guidance positions according to a map scale corresponding to the information for route search used when searching for the recommendation route, and transmits the guidance position information with respect to each one of the thinned guidance positions.

**[0028]** According to this aspect, the center side communication device transmits the guidance position information on each one of the plurality of guidance positions after thinning out the plurality of guidance positions according to a map scale corresponding to the information for route search used when searching for the recommendation route, so that it is possible to further decrease the volume of data, which are transmitted and received on the communication network.

**[0029]** Alternatively, in another aspect of the communication navigation terminal of the present invention, the center side communication device thins out the plurality of guidance positions according to a map scale of the map information for display used at the display processing device, and transmits the guidance position information with respect to each one of the thinned guidance positions.

**[0030]** According to this aspect, the center side communication device transmits the guidance position information on each one of the plurality of guidance positions after thinning out the plurality of guidance positions according to a map scale of the map information for display used at the display processing device, so that it is possible to further decrease the volume of data, which are transmitted and received on the communication network.

**[0031]** In these aspects associated with the thinning, as the number of guidance positions associated with the guidance position information to be transmitted is reduced by the thinning, the possibility that the recommendation route obtained by connecting guidance positions on the side of the communication navigation terminal becomes different from the one for which the communication center apparatus side searches increases more, independently of its extent. Therefore, each one of the aspects described above is practically advantageous as

follows:

(i) According to the first aspect, the degree of the thinning of the guidance positions can be limited according to the type of the searched recommendation route, so as to keep the possibility that the recommendation route obtained in the communication center apparatus is precisely reproduced at the communication navigation terminal.

(ii) According to the second aspect, the degree of the thinning of the guidance positions can be limited according to the map scale corresponding to the information for route search used when searching for the recommendation route, so as to keep the possibility that the recommendation route obtained in the communication center apparatus is precisely reproduced at the communication navigation terminal.

(iii) According to the third aspect, the degree of the thinning of the guidance positions can be limited according to the map scale of the map information for display used at the display processing device, so as to keep the possibility that the recommendation route obtained in the communication center apparatus is precisely reproduced at the communication navigation terminal.

**[0032]** The relationship between the reproducibility of the recommendation route at the communication navigation terminal and the degree of thinning are determined depending on the type of the map information for display used on the side of the communication navigation terminal, the type of information indicating a direction or a route to be advanced and information indicating a location included in the guidance position information, the type of information for route search, or the like. Consequently, as for how much the thinning can be allowed on each map scale or each type of a road (the recommendation route), it is preferably determined while using the system or in advance experimentally, experientially, theoretically, or simulationally with respect to each communication center apparatus and each communication navigation terminal.

**[0033]** In another aspect of the communication navigation terminal of the present invention, a map scale corresponding to the information for route search used when searching for the recommendation route agrees with a map scale of the map information for display used at the display processing device.

**[0034]** According to this aspect, connection of the guidance positions by the display processing device on a map on the same scale as that used when searching for the recommendation route on the side of the communication center apparatus can increase accuracy of reproduction of the recommendation route at the communication navigation terminal. Especially, in the case of thinning out the guidance positions according to the map scale and the type of the recommendation route, it

can increase the accuracy of reproduction of the recommendation route.

[0035] In another aspect of the communication navigation terminal of the present invention, the route search request information includes one or a plurality of passing places that exist between the origin and the destination in addition to the origin and the destination, and the search device searches for the recommendation route with respect to the route search request information.

[0036] According to this aspect, the route search request information indicating one or a plurality of passing places in addition to the origin and the destination is transmitted from the user communication terminal and the communication navigation terminal. The passing place means the place that exists between the origin and the destination and that is intended to be passed through, such as a stopping place. Then, the search device searches for the recommendation route from the origin through one or a plurality of passing places to the destination. Therefore, the communication navigation system of the present invention can effectively achieve its effect not only when not simply going to a destination, but when going through one or a plurality of passing place, such as tourist spots, restaurants, souvenir shops, and the like and then to a destination such as home, a hotel, or the like.

[0037] In another aspect of the communication navigation terminal of the present invention, the route search request information comprises screen information including character information, and is transmitted and received according to a two-way communication method.

[0038] According to this aspect, as the route search request information, screen information is transmitted and received according to a two-way communication method (a screen information two-way communication method). The screen information includes character information used in the browser, such as input processing of an origin, a destination or the like. Thus, the request of route search can be surely performed by using the user communication terminal and the communication navigation terminal.

[0039] In another aspect of the communication navigation terminal of the present invention, the route search request information includes character information, and is transmitted according to a one-way communication method.

[0040] According to this aspect, the route search request information including the character information is transmitted and received according to a one-way communication method. The character information is, for example, information used for a facsimile transmission operation or the like. Thus, the route search can be surely requested by using the user communication terminal and the communication navigation terminal independently of operation conditions or the like of the communication center apparatus. Especially, even if it is impossible to communicate in two way on the communication network because of circuit congestion, the route search

can be requested, which is useful.

[0041] In another aspect of the communication navigation terminal of the present invention, the route search request information includes transmission time information indicating a time point supposed to transmit the guidance position information, the communication center apparatus further comprises a timing device for measuring a time point shown by the transmission time information and the center side communication device transmits the guidance position information at the time point shown by the transmission time information according to the time measurement by the timing device.

[0042] According to this aspect, the communication center apparatus transmits the guidance position information defining the recommendation route searched by the search device not immediately after completing the search but following the transmission time information added to the recommendation route request information. Namely, the timing device measures a time point shown by this transmission time information and the center side communication device transmits the guidance position information at the time point supposed to transmit. Therefore, even when the communication navigation terminal to be mounted on a vehicle or the like is powered off, the route search can be requested in advance by a user terminal apparatus or the like separately and the guidance position information corresponding to the recommendation route can be received later when needed such as when starting to drive, while driving, and so on. Then, this makes it possible to display the recommendation route when needed, which is extremely useful in practice.

[0043] The above object of the present invention can be achieved by a communication center apparatus for performing two-way communication on a communication network with a communication navigation terminal provided with: (i) a terminal side communication device for receiving guidance position information that is wirelessly transmitted and that includes at least any one of information indicating a location of each one of a plurality of guidance positions, information indicating a direction to be advance at each one of the plurality of guidance positions and information indicating a route to be advanced at each one of the plurality of guidance positions; and (ii) a display processing device for displaying a route, which is obtained by connecting the plurality of guidance positions on a map shown with map information for display according to the contents of the received guidance position information, as a recommendation route on the map, the communication center apparatus comprising: a map database for storing therein map database information including information for route search, which enables a search for the recommendation route; a search device for searching for the recommendation route with respect to route search request information that indicates an origin and a destination and that is received through the communication network, on the basis of the information for route search; and a center



side communication device for wirelessly transmitting, through the communication network, the guidance position information on each one of the plurality of guidance positions located on the searched recommendation route.

**[0044]** According to this communication center apparatus, as is the case of the above-described communication navigation system of the present invention, it is possible to decrease the volume of data, which are transmitted and received between the communication center apparatus and the communication navigation terminal, as well as presenting the recommendation route at the communication navigation terminal while restraining increase of the scale of the processing and that of the apparatus at the communication navigation terminal.

**[0045]** Incidentally, as is the case of the above-described communication navigation system of the present invention, various aspects are available to the communication center apparatus for providing map information of the present invention.

**[0046]** The above object of the present invention can be achieved by a communication navigation terminal for performing two-way communication on a communication network with a communication center apparatus provided with: (i) a map database for storing therein map database information including information for route search, which enables a search for a recommendation route from an origin to a destination; (ii) a search device for searching for the recommendation route with respect to route search request information that indicates the origin and the destination and that is received through the communication network, on the basis of the information for route search; and (iii) a center side communication device for wirelessly transmitting, through the communication network, guidance position information including at least any one of information indicating a location of each one of a plurality of guidance positions located on the searched recommendation route, information indicating a direction to be advanced at each one of the plurality of guidance positions and information indicating a route to be advanced at each one of the plurality of guidance positions, the communication navigation terminal comprising: a terminal side communication device for receiving the guidance position information wirelessly transmitted; and a display processing device for displaying a route, which is obtained by connecting the plurality of guidance positions on a map shown with map information for display according to the contents of the received guidance position information, as the recommendation route on the map.

**[0047]** According to this communication navigation terminal of the present invention, as is the case of the above-described communication navigation system of the present invention, it is possible to decrease the volume of data, which are transmitted and received between the communication center apparatus and the communication navigation terminal, as well as present-

ing the recommendation route at the communication navigation terminal while restraining increase of the scale of the processing and that of the apparatus at the communication navigation terminal.

5 **[0048]** Incidentally, as is the case of the above-described communication navigation system of the present invention, various aspects are available to the communication navigation terminal of the present invention.

10 **[0049]** The above object of the present invention can be achieved by a communication navigation method executed in a communication navigation system comprising: a communication center apparatus and a communication navigation terminal, which perform two-way communication on a communication network, the method comprising: (i) at the communication center apparatus, a search process of searching for a recommendation route with respect to route search request information indicating an origin and a destination received through the communication network on the basis of information for route search that is included in map database information stored in a map database and that enables a search for the recommendation route from the origin to the destination; and a center side communication process of wirelessly transmitting, through the communication network, guidance position information including at least any one of information indicating a location of each one of a plurality of guidance positions located on the searched recommendation route, information indicating a direction to be advanced at each one of the plurality of guidance positions and information indicating a route to be advanced at each one of the plurality of guidance positions, and (ii) at the communication navigation terminal, a terminal side communication process of receiving the guidance position information wirelessly transmitted; and a display processing process of displaying a route, which is obtained by connecting the plurality of guidance positions on a map shown with map information for display according to the contents of the received guidance position information, as the recommendation route on the map.

**[0050]** According to the communication navigation method of the present invention, as is the case of the above-described communication navigation system of the present invention, it is possible to decrease the volume of data, which are transmitted and received between the communication center apparatus and the communication navigation terminal, as well as presenting the recommendation route at the communication navigation terminal while restraining increase of the scale of the processing and that of the apparatus at the communication navigation terminal.

**[0051]** Incidentally, as is the case of the above-described communication navigation system of the present invention, various aspects are available to the communication navigation method of the present invention.

**[0052]** The above object of the present invention can



be achieved by a computer program of instructions executable by a computer to perform a communication navigation method at a communication center apparatus in the above-described communication navigation system (including its various aspects), more concretely, at various component devices such as the center side communication device, the search device, the map database, or the like, provided for the communication center apparatus associated with the above-described present invention.

**[0053]** According to this computer program, the communication center apparatus associated with the present invention can be relatively easily realized as a computer reads the computer program from a recording medium and executes it or as the computer executes the program after downloading it through a communication interface or the like. Moreover, the computer program can be transmitted from another server apparatus with other data such as video information data, audio information data, map data, and so on.

**[0054]** The above object of the present invention can be achieved by a computer program of instructions executable by a computer to perform a communication navigation method at a communication navigation terminal in the above-described communication navigation system (including its various aspects), more concretely, at various component devices such as the terminal side communication device, the display processing device, or the like, provided for the communication navigation terminal associated with the above-described present invention.

**[0055]** According to this computer program, the communication navigation terminal associated with the present invention can be relatively easily realized as a computer reads the computer program from a recording medium and executes it or as the computer executes the program after downloading it through a communication interface or the like. Moreover, the computer program can be transmitted from another server apparatus with other data such as video information data, audio information data, map data, and so on.

**[0056]** The nature, utility, and further features of this invention will be more clearly apparent from the following detailed description with reference to preferred embodiments of the invention when read in conjunction with the accompanying drawings briefly described below.

#### BRIEF DESCRIPTION OF THE DRAWINGS

##### [0057]

FIG. 1 is a block diagram showing the whole structure of a communication navigation system in a first embodiment of the present invention;

FIG. 2 is a block diagram showing an example of the inner structure of a communication navigation terminal shown in FIG. 1 in the first embodiment;

FIG. 3 is a block diagram showing an example of the inner structure of a communication center apparatus for providing map information shown in FIG. 1 in the first embodiment;

FIG. 4 is a sequence chart of transmission on a communication network in the first embodiment;

FIG. 5 is a flow chart showing processing procedures of route search request at a terminal apparatus in the first embodiment;

FIG. 6A and FIG. 6B are plan views showing display screens to explain window screens of route search request in the first embodiment;

FIG. 7 is a flow chart showing processing procedures at a communication center apparatus for providing map information in the first embodiment;

FIG. 8 is a schematic diagram to explain guidance position information in the first embodiment;

FIG. 9 is a flow chart showing processing procedures at the communication navigation terminal in the first embodiment;

FIG. 10A to FIG. 10C are schematic diagrams to explain a road map displaying a recommendation route in the first embodiment; and

FIG. 11 is a sequence chart of transmission in a second embodiment.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

**[0058]** Referring to the accompanying drawings, embodiments associated with a communication navigation system and a communication navigation method, and a computer program to perform communication navigation of the present invention will be now explained. Incidentally, each embodiment, which will be described below, is intended to establish the communication navigation system of the present invention as a system that can present a recommendation route (or an optimum route) on a road map at an on-vehicle communication navigation terminal by using the communication center apparatus for providing map information.

##### (I) First Embodiment

**[0059]** Firstly, the whole structure of the communication navigation system in the first embodiment will be explained with reference to FIG. 1. FIG. 1 is a block diagram showing the whole structure of the communication navigation system in the first embodiment.

**[0060]** In FIG. 1, a digital fixed communication circuit network 1 and a digital mobile communication network 2 (hereunder, the two communication networks are collectively referred to as a communication circuit network as occasion demands), both of which are connected with a gateway (GW) device for communication protocol conversion, are provided in the first embodiment. On this communication circuit network, IP (Internet Protocol) packet communication is performed under TCP / IP

(Transmission Control Protocol / Internet Protocol) environment (e.g. the Internet).

**[0061]** The digital fixed communication circuit network 1 is connected to a communication center apparatus 3 for providing map information, a personal computer and the like. The communication center apparatus 3 is owned by communication navigation companies, for example. The personal computer is installed at a user's home. This personal computer is one example of a communication terminal 4 for users.

**[0062]** At a cell base station 2a of the digital mobile communication network 2, a cellular phone, a mobile or hand-carry type information terminal / PDA (Personal Digital Assistants), and the like are accommodated through a wireless section (air interface). An on vehicle communication navigation terminal 5 mounted on the user's vehicle is accommodated through the air interface. Incidentally, the cellular phone, and the mobile or hand carry type information terminal / PDA are other examples of the communication terminal 4.

**[0063]** The communication center apparatus 3 is constructed to perform maintenance and preservation, which have been traditionally performed at an on-vehicle navigation apparatus, of the newest map database information including the map information for display of various scales, the information for route search, and the like, which will have enormous data volume. Moreover, it is designed to perform the search processing of the recommendation route, whose load of processing is heavy, in place of the on-vehicle navigation apparatus.

**[0064]** The communication terminal 4 is constructed to request the communication center apparatus 3 to provide the map information, to search for the recommendation route, and so on. Moreover, it is constructed to give instructions of where to transmit the requested map information or the like. Incidentally, the request and the instruction of where to transmit described above can be performed from the communication navigation terminal 5 in the same manner as those from the communication terminal 4.

**[0065]** The communication navigation terminal 5 is for vehicle use. The communication navigation terminal 5 downloads the map information that is minimally required for display from among the map database information of the communication center apparatus 3 at least when displaying a map during a navigation operation. The communication navigation terminal 5 is equipped with a recording medium, such as a CD, a DVD, or the like, and stores the downloaded map information for display onto such a recording medium. Then, along with displaying the road map by using the downloaded map information, the communication navigation terminal 5 displays the recommendation route to a destination, a location of a vehicle, a moving direction, scale circle / radius, a driving locus, a map direction or orientation, and the like.

**[0066]** The communication center apparatus 3, the communication terminal 4, and the communication nav-

igation terminal 5 are equipped with a communication application program (for example, including Web browser), which will be explained in detail later.

**[0067]** Incidentally, the communication network in FIG. 1 is not especially limited to the TCP / IP method, and various data communication methods are available. It also allows the use of an analog fixed communication circuit network instead of the digital fixed communication circuit network 1.

**[0068]** Next, the communication navigation terminal 5 shown in FIG. 1 will be further explained with reference to FIG. 2. FIG. 2 is a block diagram showing an example of the inner structure of the communication navigation terminal shown in FIG. 1.

**[0069]** In FIG. 2, this communication navigation terminal 5 is provided with a self-contained positioning apparatus 10, a GPS receiver 18, a system controller 20, an input and output (I/O) circuit 21, a CD-ROM drive 31, a DVD-ROM drive 32, a hard disk device (HDD) 36, a wireless communication device 38, a display device 40, an audio output device 50, an input device 60, and an outer interface (I/F) device 61. Each component is connected to a bus line 30 for communicating processing data and control data.

**[0070]** In this embodiment, the wireless communication device 38 constructs one example of a terminal-side wireless device, and the display device 40 constructs one example of a display processing device with the system controller 20 or the like.

**[0071]** The self-contained positioning apparatus 10 is constructed by an acceleration sensor 11, an angular velocity sensor 12, and a velocity sensor 13. The acceleration sensor 11, which is constructed by a piezoelectric element, for example, outputs acceleration data obtained by detection of the acceleration of a vehicle. The angular velocity sensor 12, which is constructed by a vibration gyro, for example, outputs angular velocity data and relative azimuth data obtained by detection of the angular velocity of a vehicle when the vehicle changes its moving direction. The velocity sensor 13 detects the rotation of a vehicle shaft mechanically, magnetically, or optically and outputs signals of the number of pulses corresponding to a vehicle speed at every rotation for a predetermined angle around a vehicle shaft.

**[0072]** The GPS receiver 18 has a known structure, provided with a microprocessor unit (MPU) or a digital signal processor (DSP), a control device, a V-RAM, other memory devices and the like, as well as a high frequency reception processing device and a plane polarization non-directional receiving antenna. The GPS receiver 18 is constructed to receive electric waves  $W_a$  to  $W_c$  (when desired to obtain more reliable values, four electric waves  $W_a$  to  $W_d$ ) from at least three GPS satellites placed into orbit around the earth, to perform back-diffusion of spectra, distance measurement, Doppler measurement, and orbital data processing, and to continuously output absolute position information of a reception position (a driving position of a vehicle) from

the I/O circuit 21 to the bus line 30 after calculation of a moving velocity/azimuth and that of a location. The system controller 20 incorporates and displays it on the map road.

[0073] The system controller 20 is constructed by a CPU (Central Processing Unit) 22, a ROM (Read Only Memory) 23, which is a non-volatile solid storage element, and a RAM (Random Access Memory) 24 for working. The system controller 20 performs data communication with each component connected to the bus line 30. The data communication processing is executed by a control program and a boot program stored in the ROM 23. The RAM 24 temporarily stores setting information, which changes map display (changes it to a full-scale or local map display) by the user's operation from the input device 60, especially.

[0074] The CD-ROM drive 31 and the DVD-ROM drive 32 read out from a CD-ROM 33 and a DVD-ROM 34 and output the map D/B information (e.g. various road data, such as a road width, the number of traffic lanes, or the like, on map information (drawings)), which is stored in both the CD-ROM 33 and the DVD-ROM 34.

[0075] Incidentally, it is possible to install either one of the CD-ROM drive 31 and the DVD-ROM drive 32, and it is also possible to install one compatible drive.

[0076] The hard disk device 36 can store map (image) data, which are read by the CD-ROM drive 31 or the DVD-ROM drive 32, and after this storing, it can read out them at an arbitrary time. The hard disk device 36 can further store video data and audio data, both of which are read by the CD-ROM drive 31 and the DVD-ROM drive 32. Because of this, for example, it becomes possible to read out the video data and the audio data stored in the hard disk device 36 and output them as video and as sound, while reading out the map data on the CD-ROM 33 and the DVD-ROM 34 to perform the navigation operation. Alternatively, it becomes possible to read out the map data stored in the hard disk device 36 to perform the navigation operation, while reading out the video data and the audio data on the CD-ROM 33 and the DVD-ROM 34 and outputting them as video and as sound. Moreover, it becomes possible to output by storing in the hard disk device 36 the map data, the video data, or the audio data, which are downloaded by the wireless communication device 38, and then reading out them at an arbitrary time.

[0077] The wireless communication device 38 has the same structure as that of a general-purpose cellular phone, which is known as TDMA, TDD, or CDMA structure (a high-frequency wireless transmitting / receiving device, an encoding / decoding device, a time division multiplexing device, a control device, an audio input / output device, and the like) in the manner of PDC (Personal Digital Cellular Telecommunication System) or PHS (Personal Handyphone System), for example.

[0078] The display device 40 displays various processing data under the control of the system controller 20. A graphic controller 41 inside the display device

40 controls each component of the display device 40 on the basis of the control data transmitted from the CPU 22 through the bus line 30. Moreover, a buffer memory 42 using the V-RAM or the like temporarily memorizes immediately-displayable image information. Furthermore, along with a display control device 43 controlling display, a display 44, which is constructed by a liquid crystal display (LCD), an EL (Electro-Luminescence), or a CRT (cathode-ray tube), displays the image data outputted from the graphic controller 41. This display 44 is installed in the vicinity of a front panel in a vehicle, for example.

[0079] At the audio output device 50, a variable amplifier (AMP) 52 variably amplifies an audio analog signal outputted from a D/A converter 51 and outputs it to a speaker 53, from which it is outputted as sound, with the D/A converter 51 converting into a digital signal an audio signal transmitted through the bus line 30 under the control of the system controller 20.

[0080] The input device 60 is provided with a key, a switch, a button, a remote controller, an audio input device, and so on, to input various types of commands and data. The input device 60 is installed in the vicinity of the display 44 or a front panel of a main body of the communication navigation terminal loaded into a vehicle.

[0081] Incidentally, the communication navigation terminal 5 is not limited to the above-described structure. For example, the GPS receiver 18 is built in the communication navigation terminal 5 and is wired and connected to the I/O circuit 21; however, it is also possible to employ such a structure that a general-purpose mobile or hand-carry type GPS receiver is wired and connected (interface connected) to the outer I/F device 61 or such a wireless connection manner that allows the installation of a weak radio transmitting/ receiving device (e.g. Bluetooth frequency hopping communication manner) at the outer I/F device 61 and the general-purpose mobile or hand-carry type GPS receiver.

[0082] In the same manner as the GPS receiver 18 does, the wireless communication device 38 can also employ such a structure that a general-purpose mobile or hand-carry type cellular phone is wired and connected (interface connected) to the outer I/F device 61 or such a wireless connection manner that allows the installation of a weak radio transmitting/receiving device at the outer I/F device 61 and the general-purpose mobile or hand-carry type cellular phone.

[0083] Moreover, the input device 60 can also employ an infrared ray remote control manner and/or the same weak radio transmission / reception manner as those of the wireless communication device 38 and the GPS receiver 18. The infrared ray remote control manner is designed such that it uses a remote controller to perform infrared ray remote manipulation by user's hands, with an infrared ray reception device and a decoder built in the communication navigation terminal 5 (in general, they are installed in the vicinity of the display 44).

**[0084]** Next, the communication center apparatus 3 shown in FIG. 1 will be further explained with reference to FIG. 3. FIG. 3 is a block diagram showing an example of the inner structure of the communication center apparatus 3.

**[0085]** In FIG. 3, this communication center apparatus 3 is provided with a circuit access device 71, a microprocessor 72, a communication control device 73, a map information processing D/B device 74, a map information reading device 75, a memory device 76, an interface (I/F) device 77, a DVD-ROM 78, a communication terminal 79, a timer circuit 82, and a bus line 90.

**[0086]** In this embodiment, the communication control device 73 constitutes one example of a center side wireless device, and the map information processing D/B device 74 does one example of a search device, and the timer circuit 82 does one example of a timing device.

**[0087]** The circuit access device 71 is intended to accommodate the communication center apparatus 3 in the digital fixed communication circuit network 1, and it is provided with a DSU (Digital Service Unit), which is a terminating device, a router, a firewall, and the like, for example. Incidentally, the circuit access device 71 is equipped with a network control unit (NCU), a modulator-demodulator (modem), and the like in the case of using an analog fixed communication circuit network instead of the digital fixed communication circuit network 1 in FIG. 1.

**[0088]** The microprocessor 72 is provided with a ROM, a working RAM, and a CPU. The microprocessor 72 controls each component of the communication center apparatus 3 on the basis of a program, and its control data and processing data are exchanged through the bus line 90. The microprocessor 72 further works with the map information processing D/B device 74 to execute various data processing such as the search processing of the recommendation route or the like, which will be explained later.

**[0089]** The communication control device 73 works with the circuit access device 71 to execute communication protocol with the communication circuit network. For example, it executes TCP/IP.

**[0090]** The map information processing D/B device 74 stores the map D/B information including the map information for display of various scales, the information for route search constructed by the link information, the node information, and the like, which have enormous data volumes and which cover road networks spread in a broad area such as throughout Honshu or the main island of Japan or throughout Japan and so on. Moreover, the map information processing D/B device 74 uses this map D/B information to execute data processing, such as the search processing of the recommendation route or the like, with the microprocessor 72.

**[0091]** The map information reading device 75 operates as a drive, which reads out the map D/B information from the CD-ROM or DVD-ROM 78. The map D/B information from the CD-ROM or DVD-ROM 78 is transmit-

ted to and stored in the map information processing D/B device 74 through the bus line 90. The map D/B information at the map information processing D/B device 74 is updated by reading out data from the CD-ROM or DVD-ROM 78, which stores the newest map D/B information.

**[0092]** The memory device 76 holds information on setting an apparatus and a variable in control processing of the microprocessor 72 transmitted through the bus line 90.

**[0093]** The I/F device 77 accommodates an outer LAN (Local Area Network) to execute information processing and maintenance of various types such as replacement of the map D/B information at the map information reading device 75.

**[0094]** The communication terminal 79 is intended to incorporate the map D/B information instead of the CD-ROM or DVD-ROM 78. For example, it is intended to download (receive) on-line the map D/B information provided from a map information preparing company or association to install it in the map information processing D/B device 74. Therefore, the map D/B information at the map information processing D/B device 74 may be updated through the communication terminal 79.

**[0095]** Incidentally, in the case that this communication center apparatus 3 is used as the Internet, it will be a portal site structure. For example, it is provided with a Web server, a FTP (File Transfer Protocol) file transmitting server, a DNS (Domain Name System) server, a FAX / e-mail server, and so on.

**[0096]** A cellular phone as the communication terminal 4 shown in FIG. 1 also has a structure known as the PDC manner and the PHS manner (TDMA, TDD, or CDMA). The PDA or a compact general-purpose computer as the communication terminal 4 also has a familiar structure and performs familiar operations, and each detailed explanation will be omitted. The cellular phone as the communication terminal 4 is equipped with an application (an exclusive browser) for browsing contents of exclusive HTML (Hypertext markup language) tag description, which is accessible to the Internet. Moreover, the PDA or the compact general-purpose computer is also equipped with an application (browser / mailer application program) accessible to the Internet, which is a known structure.

**[0097]** Especially in the first embodiment having the structure to have described with reference to FIG. 1 to FIG. 3, the communication center apparatus 3 performs the route search, which has been traditionally performed inside the on-vehicle navigation apparatus, by the microprocessor 72 and the map information processing D/B device 74. Then, the communication center apparatus 3 obtains guidance position information as the result of the route search. The guidance position information includes at least any one of information indicating a location of each one of a plurality of guidance positions located on the recommendation route, information indicating a direction to be advanced at each one of the plurality

of guidance positions and information indicating a route to be advanced at each one of the plurality of guidance positions. The communication center apparatus 3 provides the guidance position information for the communication navigation terminal 5 by wireless transmission. Namely, the communication center apparatus 3 does not provide road data indicating a road of the recommendation route or coordinates information which is obtained by sampling a road of the recommendation route at equal intervals, but provides the guidance position information including information indicating a location of each "guidance position" and/or information indicating a direction or a route to be advanced at each "guidance position."

**[0098]** This "guidance position" may include a position at which there are two or more accessible routes on the recommendation route, such as an interchange, a branching point, an intersection, or the like. Furthermore, the guidance position may include a specific position such as a bridge, a tunnel, a crossing with an overpass or a underpass, U-turn area, a turning corner, or the like. Moreover, it may include various positions that have possibility of starting or stopping the use of roads by a movable body or possibility of entering or getting out of specific roads, such as a residential parking lot, a building parking lot, an exclusive parking lot, in front of one's home, at stores, in front of facilities, an on-street parking area, or the like. In any case, the guidance position means a position, which preferably has the possibility of performing route leading or route guidance of some kind through the communication navigation system to navigate a predetermined route for driving. Moreover, the "guidance position information" is intended to include all of, a couple of or any one of information among information indicating locations on the various kinds of guidance positions; information indicating a direction to be advance at these guidance positions and information indicating a route to be advance at these guidance positions.

**[0099]** The communication terminal 4 is constructed to give instructions of where to transmit the guidance position information as well as requesting the route search of the communication center apparatus 3. Incidentally, these kinds of route search requests and instructions of where to transmit can be performed from the communication navigation terminal 5 in the same manner as those from the communication terminal 4.

**[0100]** The communication navigation terminal 5 uses the guidance position information wirelessly transmitted from the communication center apparatus 3 to perform route display on a map road. Namely, according to the contents of the received guidance position information, the communication navigation terminal 5 connects the guidance positions, and then finds roads on the map shown with the map information for display, and then specifies or chooses this as the recommendation route.

**[0101]** Moreover, the guidance position information may include route guidance information. In this case, at

the communication navigation terminal 5, it is possible to perform route guidance of right turn, left turn, straight advance, or the like at each guidance position according to the route guidance information included in the guidance position information. However, the route guidance information can be reproduced on the side of the communication navigation terminal 5 on the basis of the information indicating a location of each guidance position and/or information indicating a direction or a route to be advanced at each guidance position included in the received guidance position information or on the basis of the recommendation route constructed by the connection of guidance positions. In such a case, it is not necessary to wirelessly transmit the route guidance information by including it in the guidance position information.

**[0102]** Especially in this embodiment, the map information processing D/B device 74 of the communication center apparatus 3 stores the map D/B information whose data volume is enormous and which includes a wider variety of information than the map data stored in the CD-ROM 33, the DVD-ROM 34, the HDD 36, or the like of the communication navigation terminal 5. Namely, the map D/B information includes the information for route search constructed by the link information, the node information, and the like, which cover road networks spread in a broad area such as throughout Honshu or the main island of Japan or throughout Japan and so on. The map D/B information further includes the map information for display of various scales. Moreover, the map D/B information includes data of added information, for example, such as map scales, guidance information of tourist attractions / facilities, facility numerals and the name (characters) of maps / roads, views of waters / railroads, and roads, on each map. Among them, especially the information for route search enables the route search based on the predetermined mathematical algorithm such as Dijkstra's algorithm or the like, and its data volume becomes enormous.

**[0103]** Furthermore, the search processing, which has the heavy load of processing based on the information for route search having this enormous data volume, is not performed on the side of the communication navigation terminal 5 but is executed on the side of the communication center apparatus 3 by the map information processing D/B device 74 and the microprocessor 72.

**[0104]** As described above, the CD-ROM 33, the DVD-ROM 34, the HDD 36, and the like of the communication navigation terminal 5 do not store the information for route search whose data volume is enormous, and their memory capacities are far smaller than that necessary for the map information processing D/B device 74, which is advantageous in view of simplifying the communication navigation terminal 5. Moreover, the route search based on the information for route search is not executed on the side of the communication navigation terminal 5, which causes the light load of processing in the system controller 20, so that it is again advanced

tageous in view of simplifying the communication navigation terminal 5. Furthermore, the guidance position information is wirelessly transmitted as a result of the route search, and the information for route search or the like, which has an enormous data volume, is not wirelessly transmitted, so that it is extremely advantageous in view of reducing the volume of data to be transmitted and received and in view of relatively low capacities of transmission and reception at the communication center apparatus 3 and the communication navigation terminal 5.

[0105] The data processing in the first embodiment, as designed above, and in the second embodiment, as will be described later, is executed mainly by the CPU 22 of the communication navigation terminal 5 shown in FIG. 2 and the microprocessor 72 and the map information processing D/B device 74 of the communication center apparatus 3 shown in FIG. 3. More concretely, in addition to a computer program for controlling basic operations in the navigation system such as display of a current position, display of a map, or the like, a computer program associated with display control of the recommendation route based on the guidance position information received from the communication center apparatus 3, transmission control of the route search request for the communication center apparatus 3, or the like is executed by the CPU 22 of the communication navigation terminal 5 shown in FIG. 2. On the other hand, a computer program associated with search control of the recommendation route, reception control of the route search request, or the like is executed by the microprocessor 72 and the map information processing D/B device 74 of the communication center apparatus 3 shown in FIG. 3. The computer program executed at the CPU 22 may be stored in a built-in memory device such as a RAM 24 or the like in the system controller 20 shown in FIG. 2, and it may be what is downloaded through the wireless communication device 38 or the like. On the other hand, the computer program executed at the microprocessor 72 and the map information processing D/B device 74 may be stored in the memory device 76, the DVD-ROM 78, or the like shown in FIG. 3, and it may be what is downloaded through the circuit access device 71, the communication terminal 79, or the like.

[0106] Next, the whole of the operational flow mainly associated with display, search, search request, or the like of the recommendation route in the first embodiment will be explained with reference to a sequence chart in FIG. 4 in addition to FIG. 1 to FIG. 3.

[0107] In FIG. 4, the route search request for an origin and a destination from the communication terminal 4 is firstly performed (step SA). In this case, one or a plurality of passing place may be included in the contents of the request in addition to the origin and the destination. The passing place means the place that exists between the origin and the destination and that is intended to be passed through, such as stopping place or the like. Incidentally, as described above, the route search request

can be performed from the communication navigation terminal 5.

[0108] Secondly, as soon as the communication center apparatus 3 receives this route search request information, it executes a search for the recommendation route corresponding to the route search request information. In other words, it performs the route search, which is typically performed by each navigation apparatus, and transmits to the communication navigation terminal 5 the guidance position information associated with the recommendation route as the result of the search (step SB).

[0109] Then, the communication navigation terminal 5, which receives this guidance position information, executes processing of connecting various roads on a map, which are shown with the map information for display owned by it, according to the contents of the guidance position information and screen-displays the recommendation route from an origin to a destination with dashed lines, thick lines, and the like of specific colors on a map (step SC). For example, the communication navigation terminal 5 connects a plurality of guidance positions on a map for display such that they are along main roads and the like by interpolating parts, which are between a plurality of guidance positions, on the map for display or a road map according to the contents of guidance position information, so that it can specify or choose the recommendation route.

[0110] Next, the route search request (step SA in FIG. 4) by the communication terminal 4 shown in FIG. 4 will be further explained with reference to FIG. 5 and FIG. 6. FIG. 5 is a flow chart showing processing procedures of route search request at communication terminal 4. FIG. 6A and FIG. 6B are plan views showing display screens to explain the window screen of route search request.

[0111] In FIG. 5, the communication terminal 4 prepares the route search request information including information indicating an origin, a destination, a place to stop at, a destination date / time, where to transmit information, or the like, as will be described later, as well as information indicating request of searching for the recommendation route (step S1).

[0112] Then, the communication terminal 4 accesses the communication center apparatus 3 with a password, an identification numeral (ID), or the like, which is given in advance (step S2 and step S3).

[0113] Then, the communication terminal 4 transmits the route search request information to the communication center apparatus 3 (step S4).

[0114] Here, as shown in FIG. 6A and FIG. 6B, there are the following two methods (A) and (B) to request the route search performed in step S1 to step S4.

(A) A method of transmitting the route search request information by e-mail

[0115] In a transmission method under the TCP / IP



environment, the communication terminal 4 executes a mailer application program to transmit the route search request information. In this case, the route search request information contains instructions of the request of a magnified map of an origin and a destination and a full-scale map between the origin and the destination as well as the address of the origin and the destination (the name of stations and districts are also available) as displayed in a screen window of the communication terminal 4 (an example of a cellular phone) shown in FIG. 6A. Moreover, this route search request information contains where to transmit (e.g. the address and the phone number of the communication navigation terminal 5) information indicating the searched recommendation route (i.e. the guidance position information on the recommendation route) from the communication center apparatus 3 as well as a transmission time (immediacy or designated time).

(B) A method in the case that the communication center apparatus 3 is a portal site

[0116] By browsing with a Web browser mounted on the communication terminal 4 (which is a compact general-purpose computer in this case), the communication center apparatus 3 is accessed and the object of a map menu "a map of the whole country, districts (tourist attractions etc.), prefecture and municipality unit, and so on" as shown in FIG. 6B, which is transmitted from the communication center apparatus 3, is designated. The map information by this designation is transmitted to the communication terminal 4 from the communication center apparatus 3. The communication terminal 4 side performs pointer instruction of a destination from an origin or that of a destination via passing places from the origin on this map screen and gives instructions of the route search request related to requirement of a magnified map as occasion demands. Moreover, it inputs where to transmit (e.g. the phone number and the address of the communication navigation terminal 5) information indicating the searched recommendation route (i.e. the guidance position information on the recommendation route) from the communication center apparatus 3 as well as the transmission time (immediacy or designated time). These pieces of instruction information are transmitted to the communication center apparatus 3 from the communication terminal 4 by executing a utility program at a browser.

[0117] Incidentally, it is also possible to input the address of the origin and the destination in the same manner as the above-described method (A) to request the route search, instead of the instruction of the object to the map menu.

[0118] Next, the search processing (step SB in FIG. 4) of the recommendation route at the communication center apparatus 3 will be further explained with reference to FIG. 7 and FIG. 8. FIG. 7 is a flow chart showing processing procedures at the communication center ap-

paratus 3 shown in FIG. 3. FIG. 8 is a schematic diagram to explain guidance position information, which the communication center apparatus 3 transmits to the communication navigation terminal 5.

[0119] Firstly, in FIG. 7, when the communication center apparatus 3 receives the route search request information from the communication terminal 4 (step S11 and step S12), the communication center apparatus 3 classifies the route search request information according to the contents of the route search request information (step S13). Namely, the classification is performed according to the contents of the route search request information instructed by the communication terminal 4 at the process of the route search request, as described with reference to FIG. 5 and FIG. 6, for example. More concretely, the classification is performed according to the following information (a) to (i):

- (a) information on the address (or the name of stations or districts) of an origin and a destination
- (b) information on the requirement of a magnified map of an origin and a destination (or these and passing places) or a full-scale map between an origin and a destination
- (c) information on the requirement of a map menu from the communication terminal 4
- (d) transmission of map information on a map menu from the communication center apparatus 3
- (e) information on reception of the instruction of a transmission requirement map screen (a map menu) at the communication terminal 4
- (f) information on reception of instructions between an origin and a destination from the communication terminal 4
- (g) information on reception of the requirement of guidance information indicating in detail specific districts from the communication terminal 4
- (h) information on reception of where to transmit (phone number and address) from the communication terminal 4
- (i) information on reception of a transmission time (immediacy or designated time) from the communication terminal 4

[0120] Among them, instructions of the above two pieces of information (a) and (b) are given by email in FIG. 6A as described above. Moreover, the above four pieces of information (c) to (f) are executed through a portal site screen in FIG. 6B.

[0121] Then, after the classification processing in step S13, the contents of the above pieces of information (a) and (b) are temporarily stored and flag F1 and flag F2 are set in respective one of files (step S14 and step S15). Moreover, the above pieces of information (c), (d), (e), and (f) are processed and flag F3 is set to the content of the information (f) (step S16 to step S19). Furthermore, the above pieces of information (g), (h), and (i) are processed and flag F4, flag F5, and flag F6 are



set to the contents of these three pieces of information, respectively and in this order (step S20 to step S22).

[0122] Then, the information contents (origin / destination) of the flag F1 in step S14 and the flag F3 in step S19 are incorporated and tracking by a D/B engine is executed at the map information processing D/B device 74 (step S23) to perform the route search (step S24). This tracking is performed with respect to many pieces of map information (drawings) in some cases according to the range of an origin and a destination of the route search request. Here, it will be explained under the assumption that the tracking is executed with respect to one piece of map information (drawings). In this case, a route which has the shortest driving distance and /or which has the shortest driving time is chosen and stored as the recommendation route by executing cost calculation, for example.

[0123] Then, a plurality of guidance positions on this recommendation route are thinned out according to the scale of map information or the type of the recommendation route (e.g. expressway, national road, local street, city street, or the like). For example, in the case that there is an expressway between an origin and a destination, guidance positions located between the entrance and the exit of this expressway are thinned out. Flag F7 is set to guidance position information on the plurality of guidance positions after this thinning. Moreover, in the case that it is relatively distant between an origin and a destination and that there is a road given to a name (e.g. Route 1) between them, again, guidance positions between a connection part on this road (entrance) and a connection part on another road (exit) are thinned out (step S25). Furthermore, flag F8 is set to the scale of a map (e.g. 1/xxx) corresponding to the information for route search used when searching for the recommendation route (step S26).

[0124] This thinning reduces the data volume (traffic volume) of guidance position information defining the recommendation route when wirelessly transmitting it to the communication navigation terminal 5 from the communication center apparatus 3, so that congestion at the communication center apparatus 3 may be hardly generated, which makes it easy to access respective one of circuits with respect to many route search requests.

[0125] Now, one example of the guidance position information defining the recommendation route is shown in FIG. 8.

[0126] In the example shown in FIG. 8, the guidance position information includes information Pli indicating a location of each guidance position and information Dli indicating an azimuth (direction) or a route to be advanced. The information Pli may be absolute coordinates (Xi, Yi) as is the case with an origin, for example (wherein i = a, ..., g). Alternatively, it may be relative coordinates ( $\Delta x_i$ ,  $\Delta y_i$ ) that is a variation with an origin's coordinates (Xa, Yb) as a standard (wherein  $\Delta x_i = X_i - X_a$ ,  $\Delta y_i = Y_i - Y_a$ ) or relative coordinates that is a variation with a destination's coordinates (Xg, Yg) as a

standard. On the other hand, the information Dli may be a code or codes indicating a moving direction indicating the type of left turn, right turn, straight advance, or the like at each guidance position. Alternatively, it may be an azimuth (an absolute azimuth) a to be advanced at each guidance position or a two-dimensional angle of the direction of advancing to the direction of entering each guidance position. In FIG. 8, each guidance position is surrounded by a circle and an arrow, which connects the direction that a vehicle enters the corresponding guidance position and the direction that it leaves this, is shown inside each circle. Moreover, the recommendation route is shown with dotted lines as a road connected with the plurality of arrows.

[0127] Incidentally, in FIG. 8, in the case that a road between an origin and a destination is an expressway, for example, and if the origin and the destination are extracted as the guidance positions, it becomes possible to perform mapping (adaptation display processing) onto a road on the side of the communication navigation terminal 5, which will be explained later.

[0128] Moreover, as for the above-described thinning, its thinning condition (rate) is preferably variable for each map scale. For example, in the case that an origin and a destination are set in a relatively broad area on a map of a country, even if some of the guidance positions of each road that is located between a plurality of main highways we pass through (a road between the entrance and the exit of each main highway) are thinned out, a user has no difficulty in its driving.

[0129] In this case, the data volume (traffic volume) wirelessly transmitted to the communication navigation terminal 5 from the communication center apparatus 3 is reduced more.

[0130] Then, in the case that the information contents corresponding to the flag F4 is stored (i.e. in the case that information indicating in detail a specific district Po of a destination or a specific district Pi of an origin shown in FIG. 8 is being required), the route search is processed as is the case with the recommendation route search of an origin and a destination described above. Namely, the recommendation route search indicating in detail the specific district Po or Pi required from the communication terminal 4 is executed with the tracking by the D/B engine at the map information processing D/B device 74 and the searched route is extracted. The specific district Po or Pi is an area surrounding stations of an origin and a destination, for example. Then, the recommendation route that has the shortest driving route is chosen, for example, and flag F9 is set to guidance position information defining the recommendation route (step S27).

[0131] Then, the information contents corresponding to the flag F5 (phone number and address of where to transmit) is incorporated and is set to the communication control device 73 in FIG. 3 (step S28).

[0132] Then, the information contents corresponding to the flag F6 (transmission time) is read out (step S29).

In the case that immediacy is designated (step S30: YES), the information contents corresponding to the flag F7 (the guidance information defining the whole of the recommendation route in the processing in step S25) (between an origin and a destination), the information contents corresponding to the flag F8 (scale information), and the information contents of the flag F9 (the guidance information defining the recommendation route in specific districts in the processing in step S27), all of which are stored in the memory device 76 and/or the map information processing D/B device 74, are transmitted to the communication circuit network from the communication control device 73 with respect to the phone number and the address of the communication navigation terminal 5 (step S32). In the case that it is not necessary to transmit immediately (not-immediate transmission) in step S30, i.e. in the case that the transmission time is designated (step S30: NO), when the time is measured with the time circuit 82 (step S31), the information contents corresponding to the flag F7, the flag F8, and the flag F9 are transmitted as is the case with the immediate transmission described above (step S32).

**[0133]** In the search processing of the recommendation route, the recommendation route that has the shortest driving distance, for example, is chosen among a plurality of routes, which are obtained by the processing. However, it is possible to perform weighting and choose the substantial recommendation route. For example, it is also possible to choose the recommendation route, which consequently has the shortest driving time after considering traffic congestion with traffic information (VICS; Vehicle Information and Communication System).

**[0134]** Next, the process (i.e. step SC in FIG. 4) of specifying or choosing the recommendation route from among many roads shown with map information for display or road map information on the basis of the guidance position information received on the side of the communication navigation terminal 5 to display as a road map including the recommendation route will be further explained with reference to FIG. 9 and FIG. 10. FIG. 9 is a flow chart showing processing procedures at the communication navigation terminal 5 shown in FIG. 2. FIG. 10A to FIG. 10C are plan views showing display screens to explain a road map displaying a recommendation route.

**[0135]** In FIG. 9, when the communication navigation terminal 5 receives the information contents of the flag F7, the flag F8, and the flag F9 from the communication center apparatus 3 (step S41), the communication navigation terminal 5 classifies the information contents of these flags F7 to F9 (step S42). Then, the guidance position information defining the whole of the recommendation route of the flag F7 is filed (step S43). Then, according to the contents of this guidance position information defining the whole of the recommendation route (refer to FIG. 8), tracking is performed by the D/B engine

for a road on a map shown with the map information for display, which is owned in advance on the side of the communication navigation terminal 5, with respect to each guidance position. Alternatively, the mapping of a plurality of guidance positions is performed onto a road by specifying guidance positions in order from an origin (step S44 and step S45). The map information for display is information read out to the hard disk device 36 from the CD-ROM drive 31 or the DVD-ROM drive 32 in FIG. 2. In the tracking process by the D/B engine, a node intersection on a road shown with this map information for display and a plurality of guidance positions (refer to FIG. 8) on the whole of the recommendation route are arranged onto the road such that they matches the road.

**[0136]** When connecting a plurality of guidance positions, if the guidance position information includes not only information indicating a location but also information indicating an azimuth (direction) or a route to be advanced, which indicates the type of left turn, right turn, straight advance, or the like, for example, it is relatively easy to choose or specify a route (the recommendation route) that guidance positions match on a map shown with the map information for display and also its accuracy is high. Especially, if the scale of a map used when searching for the recommendation route at the communication center apparatus 3 is the same as that of a map used when mapping or arranging guidance positions on a route at the communication navigation terminal 5, it is possible to produce at the communication navigation terminal 5 an exact copy of the recommendation route searched at the communication center apparatus 3 extremely accurately.

**[0137]** Therefore, it is possible to include, in the route search request information, information indicating the map scale of the map information for display to be used for display processing at the communication navigation terminal 5, transmit it to the communication center apparatus 3 before search processing, and use information for route search corresponding to the map scale shown with this received route search request information to perform search processing at the microprocessor 72 and the map information processing D/B device 74 which can perform search processing by the information for route search corresponding to many map scales.

**[0138]** In the same manner, the guidance information defining the recommendation route in the specific districts corresponding to the flag F9 to have been classified in step S42 is filed (step S46) and mapping and tracking are performed as is the case with the guidance position information defining the whole of the recommendation route corresponding to the flag F7 described above (step S47 and step S48).

**[0139]** As for the tracking and the mapping, they are separately and preferably referred to the scale information corresponding to the flag F8 to have been classified in step S42 and are executed to a map of the same scale at the hard disk device 36 in FIG. 2 (step S49). The processing data of step S45 and step S48 obtained

above are chosen by operating the input device 60 in FIG. 2 and its screen display is performed (step S50 and step S51).

[0140] FIG. 10A to FIG. 10C show screens displayed in the above manner. In FIG. 10A, a road (i.e. a recommendation route) obtained by connecting a plurality of guidance positions in FIG. 8 is shown in a thick line. Incidentally, this figure illustrates a current position of a vehicle as a reference. Moreover, maps obtained in the case that an area surrounding a station as the specific district Pi of an origin and that as the specific district Po of a destination shown in FIG. 8 are chosen are respectively shown in FIG. 10B and FIG. 10C.

[0141] Incidentally, this screen display is the same as the case of a single use when mounting the navigation apparatus on a vehicle as is the existing manner and it is performed along with guidance information as sound or the like. Onto the display screen, a display road map, a location of a vehicle, a moving direction, a scale circle / radius, a driving locus, map directions, or the like, all of which are not illustrated in FIG. 10A to FIG. 10C, are given. In addition, various guidance in driving of a vehicle, e.g. the guidance of facilities and that of moving directions performed just before reaching the node intersection according to route guidance information and further facility guidance information, which are newly generated depending on the recommendation route on the side of the communication navigation terminal 5 or which are included in guidance position information, is performed as well. The operations of these various types of guidance, their choosing instructions, and the like are well known, and their detailed explanations are omitted here.

[0142] As described above, at the communication navigation terminal 5, it is not necessary to execute the recommendation route search that has the enormous number of processing steps. In other words, it becomes possible to execute more control processing in a control system, which may develop multifunctionalization (e.g. unification with a television apparatus, an audio apparatus, and the like).

## (II) Second Embodiment

[0143] Next, the second embodiment will be explained with reference to FIG. 1 to FIG. 3 and FIG. 11. The whole of the structure of the second embodiment is the same as that of the first embodiment shown in FIG. 1 to FIG. 3. FIG. 11 is a flow chart showing processing procedures of main parts at the communication center apparatus 3 in the second embodiment.

[0144] In FIG. 11, route search request is performed from a facsimile device (not illustrated in FIG. 11) in the second embodiment instead of the communication terminal 4 (or the communication navigation terminal 5) used in the first embodiment. Hereunder, the extraction of route search request information at the communication center apparatus 3 will be explained.

[0145] In FIG. 1 to FIG. 3 and FIG. 11, the communication control device in the communication center apparatus 3 in FIG. 3 mounts therein a facsimile transmission, e.g. a communication protocol in G3 method and/or G4 method of ITU-T / T.30 recommendation.

[0146] In the route search request by facsimile communication, firstly, the route search request information by processings (1), (2), or (3), which will be explained below, is transmitted to the communication center apparatus 3 from the facsimile device (step S61). This route search request information includes a phone number of where to transmit, an address of a destination from a desired origin in the same manner of that in the first embodiment. At the communication center apparatus 3, the route search request information obtained by using the facsimile device is received (step S62) and the classification of it is performed (step S63). At the communication center apparatus 3, the route search request information is obtained by the following (1) to (3) (step S64 to step S66).

(1) The route search request information is stored in a nonstandard procedure area (free area to use) in a transmission format or the like in G3 method standard of ITU-T / T.30 recommendation and it is transmitted to the communication center apparatus 3 from the facsimile device. The communication center apparatus 3 extracts the route search request information from the nonstandard procedure area.

(2) The route search request information is described in a facsimile document and it is transmitted to the communication center apparatus 3 from the facsimile device. The communication control device 73 (refer to FIG. 3) of the communication center apparatus 3 extracts the route search request information by known Character Recognition.

(3) The communication center apparatus 3 decodes a dual tone signal (a signal having two mixed frequency allocated for each DTMF / key) in a push button (PB) phone method to extract the route search request information, which is determined in advance.

[0147] Other processings are performed in the same manner as those in the first embodiment (step S67 to step S69) and the recommendation route is screen-displayed on a map at the communication navigation terminal 5.

[0148] As described above, in the second embodiment, it becomes possible to transmit route search request information from a facsimile device, so that even if the communication terminal 4 and the communication navigation terminal 5 cannot be used at a place we moved to (e.g. out of a communication service area), it becomes possible to request and provide the recommendation route.

[0149] Incidentally, we explained each embodiment

described above with such an example that the communication center apparatus 3 is installed at the digital fixed communication circuit network 1 and that the communication navigation terminal 5 is mounted on a vehicle; however, the present invention is not limited to this. For example, it is within the scope of designed matters of the present invention that the communication center apparatus 3 is installed at a satellite station and/or a station on the earth in satellite communication and the present invention is used for a communication navigation system on a global scale with the communication navigation terminal 5 as a mobile or hand-carry type.

[0150] Moreover, each embodiment described above may be designed such that typical navigation operations such as display of a surrounding map of a current position, display of the current position on the surrounding map, display of facility guidance information, or the like are at least partially performed on the side of the communication center apparatus 3 in the same manner as the search processing of the recommendation route described above. Alternatively, it may be designed such that the typical navigation operations in this kind are performed on the side of the communication navigation terminal 5 for a vehicle by using various pieces of information stored in the CD-ROM 33 or the DVD-ROM 34 aside from the search processing of the recommendation route described above.

[0151] Furthermore, the communication navigation terminal 5 of the present invention may be applied for various navigation terminals, not for a vehicle as described in each embodiment above, but for various movable bodies such as an airplane, a ship, a bicycle, or the like. It may be further applied for those for an animal and a pedestrian, who uses a mobile phone, a mobile or hand-carry type information terminal, or the like.

## Claims

1. A communication navigation system, **characterized in that** the communication navigation system comprises: a communication center apparatus (3); and a communication navigation terminal (5), which perform two-way communication on a communication network (1, 2),

(i) the communication center apparatus comprises:

a map database (74) for storing therein map database information including information for route search, which enables a search for a recommendation route from an origin to a destination;  
a search device (72) for searching for the recommendation route with respect to route search request information that indicates the origin and the destination and

that is received through the communication network, on the basis of the information for route search; and

a center side communication device (71, 73) for wirelessly transmitting, through the communication network, guidance position information including at least any one of information indicating a location of each one of a plurality of guidance positions located on the searched recommendation route, information indicating a direction to be advanced at each one of the plurality of guidance positions and information indicating a route to be advanced at each one of the plurality of guidance positions, and

(ii) the communication navigation terminal comprises:

a terminal side communication device (38) for receiving the guidance position information wirelessly transmitted; and  
a display processing device (20, 40) for displaying a route, which is obtained by connecting the plurality of guidance positions on a map shown with map information for display according to the contents of the received guidance position information, as the recommendation route on the map.

2. A communication navigation system according to claim 1, **characterized in that** the terminal side communication device transmits the route search request information and the center side communication device receives the route search request information.
3. A communication navigation system according to claim 1, **characterized in that** the communication navigation system further comprises a user communication terminal (4), which performs two-way communication on the communication network and which transmits the route search request information.
4. A communication navigation system according to any one of claims 1 to 3, **characterized in that**, if the searched recommendation route includes an expressway, the plurality of guidance positions include at least one of a parking area, a service area, and an interchange on the expressway.
5. A communication navigation system according to any one of claims 1 to 4, **characterized in that** the center side communication device thins out the plurality of guidance positions according to the type of the searched recommendation route, and transmits the guidance position information with respect to

each one of the thinned guidance positions.

6. A communication navigation system according to any one of claims 1 to 5, **characterized in that** the center side communication device thins out the plurality of guidance positions according to a map scale corresponding to the information for route search used when searching for the recommendation route, and transmits the guidance position information with respect to each one of the thinned guidance positions. 5
7. A communication navigation system according to any one of claims 1 to 5, **characterized in that** the center side communication device thins out the plurality of guidance positions according to a map scale of the map information for display used at the display processing device, and transmits the guidance position information with respect to each one of the thinned guidance positions. 15
8. A communication navigation system according to any one of claims 1 to 7, **characterized in that** a map scale corresponding to the information for route search used when searching for the recommendation route agrees with a map scale of the map information for display used at the display processing device. 20
9. A communication navigation system according to any one of claims 1 to 8, **characterized in that** the route search request information includes one or a plurality of passing places that exist between the origin and the destination, and the search device searches for the recommendation route with respect to the route search request information. 25
10. A communication navigation system according to any one of claims 1 to 9, **characterized in that** the route search request information comprises screen information including character information, and is transmitted and received according to a two-way communication method. 30
11. A communication navigation system according to any one of claims 1 to 9, **characterized in that** the route search request information includes character information, and is transmitted according to a one-way communication method. 35
12. A communication navigation system according to any one of claims 1 to 11, **characterized in that** the route search request information includes transmission time information indicating a time point supposed to transmit the guidance position information, the communication center apparatus further comprises a timing device (82) for measuring a time 40

point shown by the transmission time information and

the center side communication device transmits the guidance position information at the time point shown by the transmission time information according to the time measurement by the timing device.

13. A communication center apparatus (3) for performing two-way communication on a communication network (1, 2) with a communication navigation terminal (5) provided with: (i) a terminal side communication device (38) for receiving guidance position information that is wirelessly transmitted and that includes at least any one of information indicating a location of each one of a plurality of guidance positions, information indicating a direction to be advance at each one of the plurality of guidance positions and information indicating a route to be advanced at each one of the plurality of guidance positions; and (ii) a display processing device (20, 43) for displaying a route, which is obtained by connecting the plurality of guidance positions on a map shown with map information for display according to the contents of the received guidance position information, as a recommendation route on the map, **characterized in that** the communication center apparatus comprises: 45

a map database (74) for storing therein map database information including information for route search, which enables a search for the recommendation route;

a search device (72) for searching for the recommendation route with respect to route search request information that indicates an origin and a destination and that is received through the communication network, on the basis of the information for route search; and a center side communication device (71, 73) for wirelessly transmitting, through the communication network, the guidance position information on each one of the plurality of guidance positions located on the searched recommendation route. 50

14. A communication navigation terminal (5) for performing two-way communication on a communication network (1, 2) with a communication center apparatus (3) provided with: (i) a map database (74) for storing therein map database information including information for route search, which enables a search for a recommendation route from an origin to a destination; (ii) a search device (72) for searching for the recommendation route with respect to route search request information that indicates the origin and the destination and that is received through the communication network, on the basis 55

of the information for route search; and (iii) a center side communication device (71, 73) for wirelessly transmitting, through the communication network, guidance position information including at least any one of information indicating a location of each one of a plurality of guidance positions located on the searched recommendation route, information indicating a direction to be advanced at each one of the plurality of guidance positions and information indicating a route to be advanced at each one of the plurality of guidance positions, **characterized in that** the communication navigation terminal comprises:

a terminal side communication device (38) for receiving the guidance position information wirelessly transmitted; and  
a display processing device (20, 40) for displaying a route, which is obtained by connecting the plurality of guidance positions on a map shown with map information for display according to the contents of the received guidance position information, as the recommendation route on the map.

15. A communication navigation method executed in a communication navigation system comprising: a communication center apparatus (3) and a communication navigation terminal (5), which perform two-way communication on a communication network (1, 2), **characterized in that** the communication navigation method comprises:

(i) at the communication center apparatus,

a search process of searching for a recommendation route with respect to route search request information indicating an origin and a destination received through the communication network on the basis of information for route search that is included in map database information stored in a map database and that enables a search for the recommendation route from the origin to the destination; and

a center side communication process of wirelessly transmitting, through the communication network, guidance position information including at least any one of information indicating a location of each one of a plurality of guidance positions located on the searched recommendation route, information indicating a direction to be advanced at each one of the plurality of guidance positions and information indicating a route to be advanced at each one of the plurality of guidance positions, and

(ii) at the communication navigation terminal,

a terminal side communication process of receiving the guidance position information wirelessly transmitted; and

a display processing process of displaying a route, which is obtained by connecting the plurality of guidance positions on a map shown with map information for display according to the contents of the received guidance position information, as the recommendation route on the map.

16. A computer program of instructions executable by a computer to perform a communication navigation method at a communication center apparatus (3) in a communication navigation system, the communication navigation system comprising the communication center apparatus and a communication navigation terminal (5), the communication center apparatus performing two-way communication on a communication network (1, 2) with the communication navigation terminal, the communication navigation terminal comprising: (i) a terminal side communication device (38) for receiving guidance position information that is wirelessly transmitted and that includes at least any one of information indicating a location of each one of a plurality of guidance positions, information indicating a direction to be advanced at each one of the plurality of guidance positions and information indicating a route to be advanced at each one of the plurality of guidance positions; and (ii) a display processing device (20, 40) for displaying a route, which is obtained by connecting the plurality of guidance positions on a map shown with map information for display according to the contents of the received guidance position information, as a recommendation route on the map, **characterized in that** the communication navigation method comprises:

a search process of searching for the recommendation route with respect to route search request information indicating an origin and a destination received through the communication network on the basis of information for route search that is included in map database information stored in a map database and that enables a search for the recommendation route from the origin to the destination; and  
a center side communication process of wirelessly transmitting, through the communication network, the guidance position information on each one of the plurality of guidance positions located on the searched recommendation route.

17. A computer program of instructions executable by

a computer to perform a communication navigation method at a communication navigation terminal (5) in a communication navigation system, the communication navigation system comprising a communication center apparatus (3) and the communication navigation terminal, the communication navigation terminal performing two-way communication on a communication network (1, 2) with the communication center apparatus, the communication center apparatus comprising: (i) a map database (74) for storing therein map database information including information for route search, which enables a search for a recommendation route from an origin to a destination; (ii) a search device (72) for searching for the recommendation route with respect to route search request information that indicates the origin and the destination and that is received through the communication network, on the basis of the information for route search; and (iii) a center side communication device (71, 73) for wirelessly transmitting, through the communication network, guidance position information including at least any one of information indicating a location of each one of a plurality of guidance positions located on the searched recommendation route, information indicating a direction to be advanced at each one of the plurality of guidance positions and information indicating a route to be advanced at each one of the plurality of guidance positions, **characterized in that** the communication navigation method comprises:

a terminal side communication process of receiving the guidance position information wirelessly transmitted; and  
a display processing process of displaying a route, which is obtained by connecting the plurality of guidance positions on a map shown with map information for display according to the contents of the received guidance position information, as the recommendation route on the map.

45

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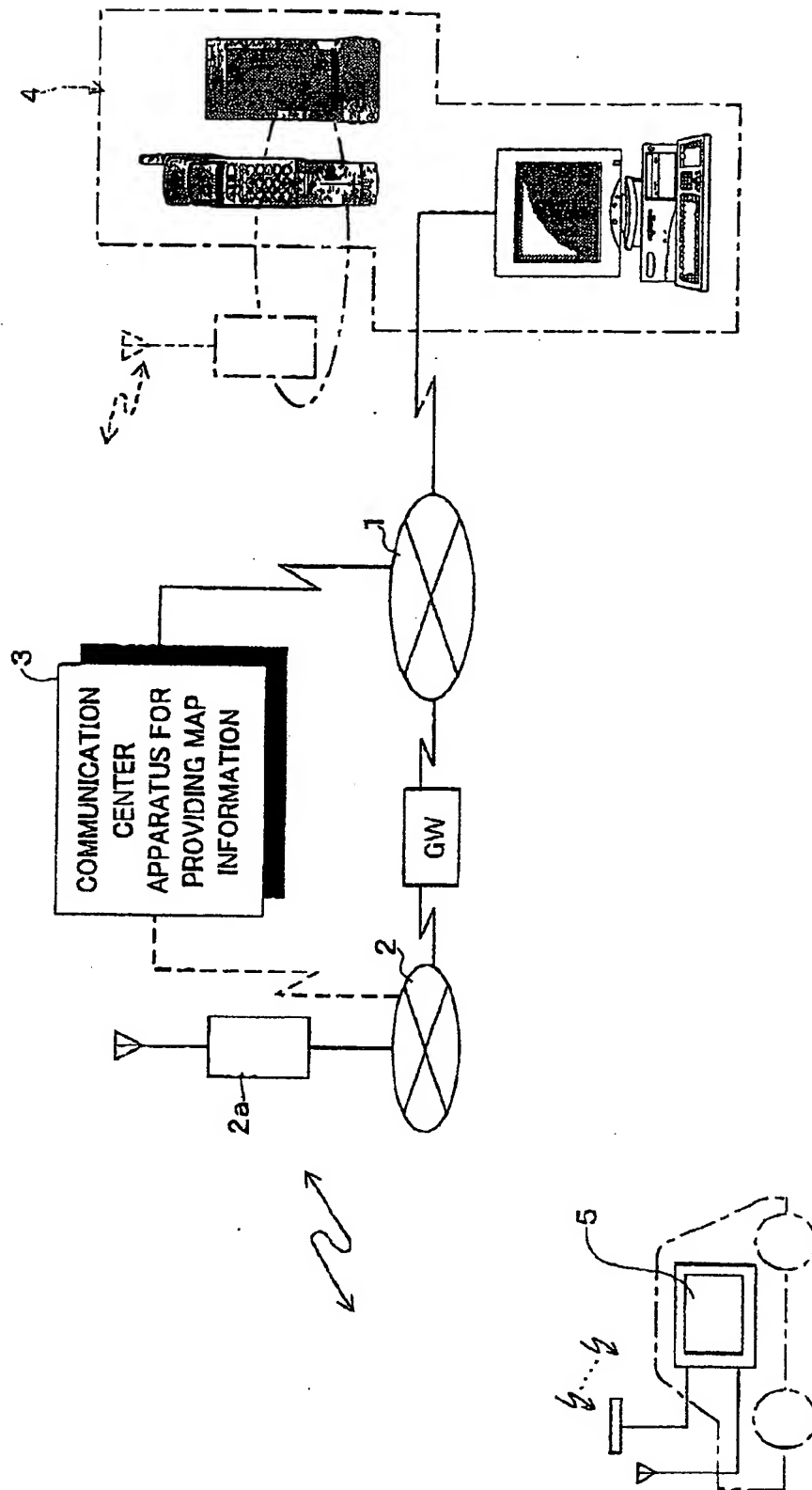


FIG. 1

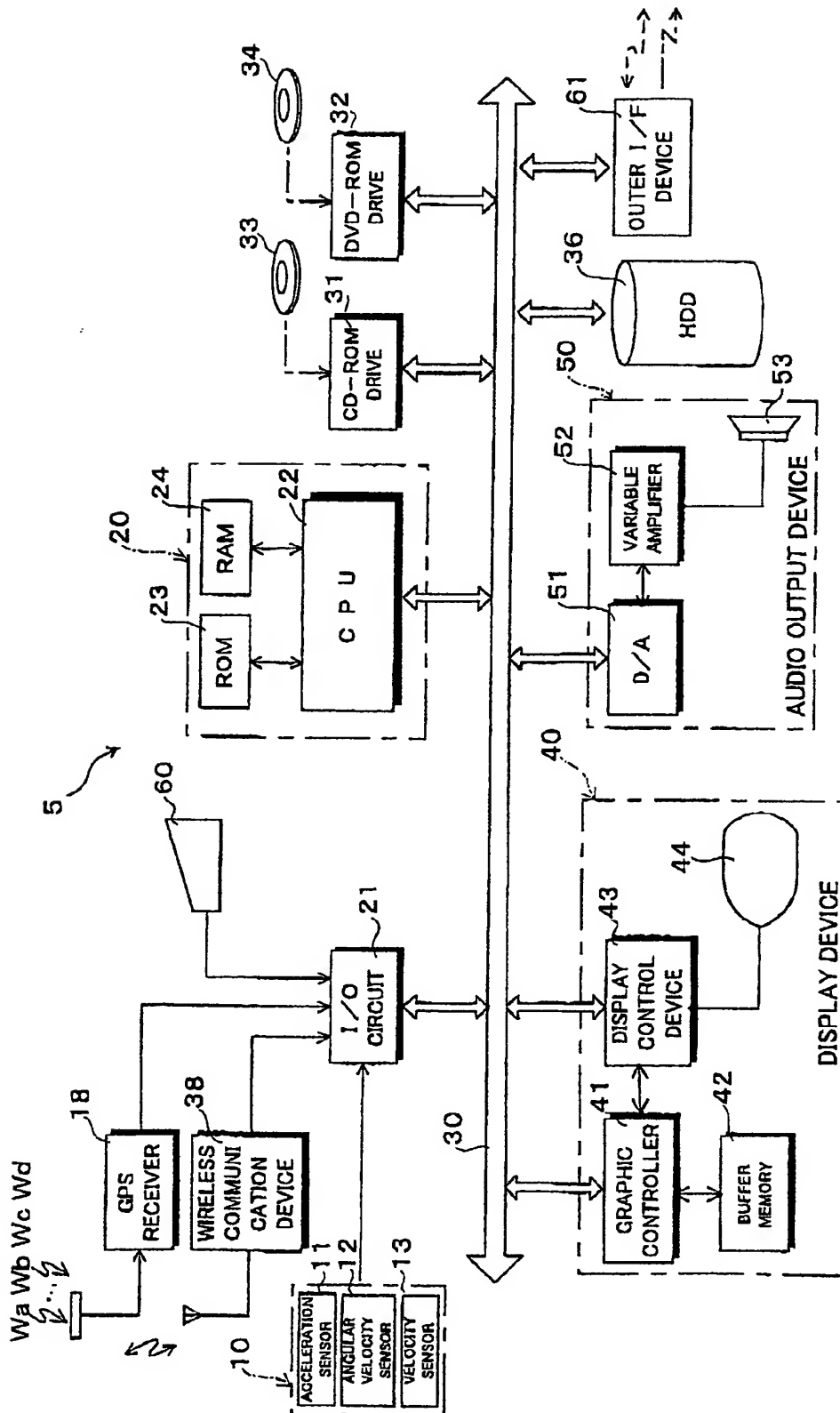


FIG. 2

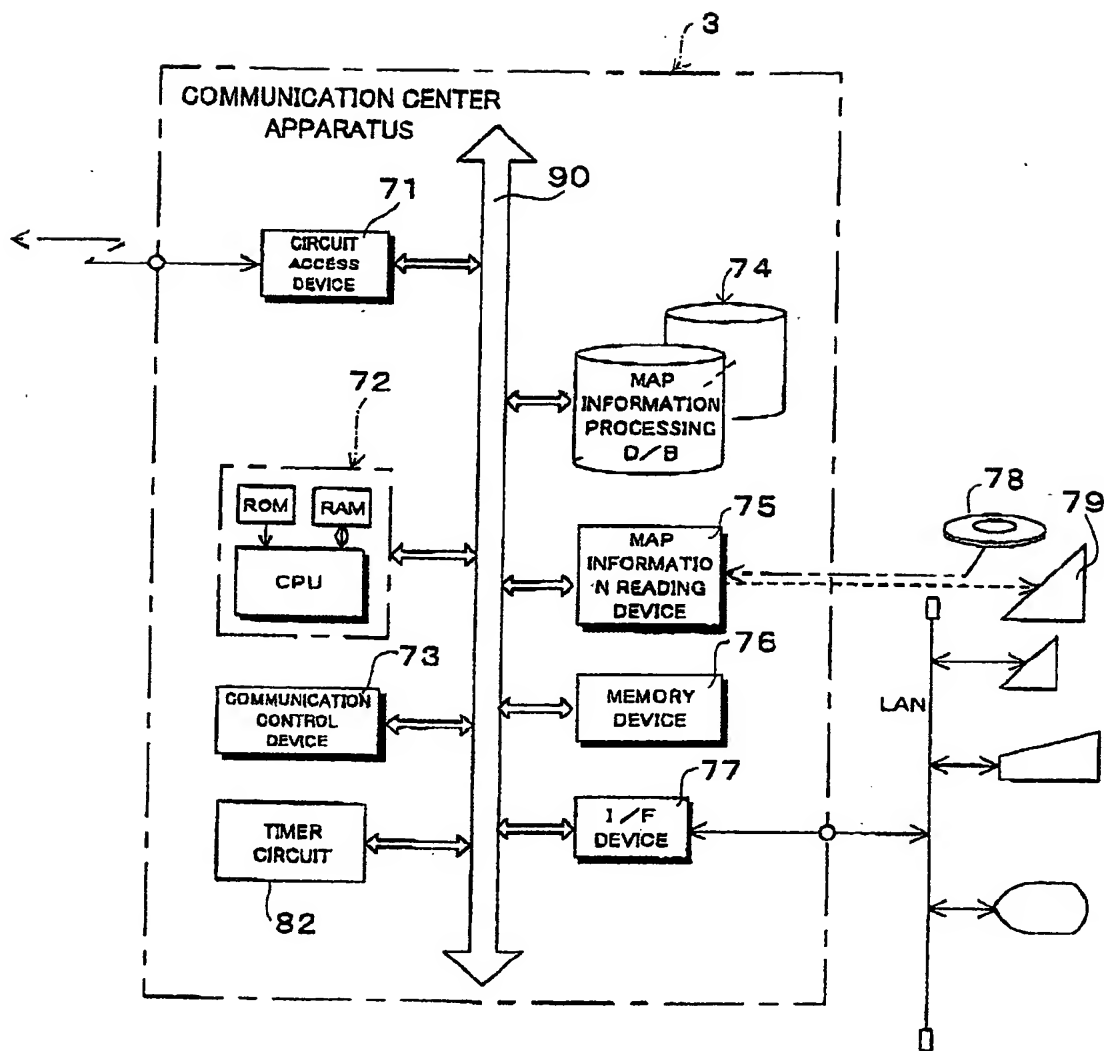


FIG. 3

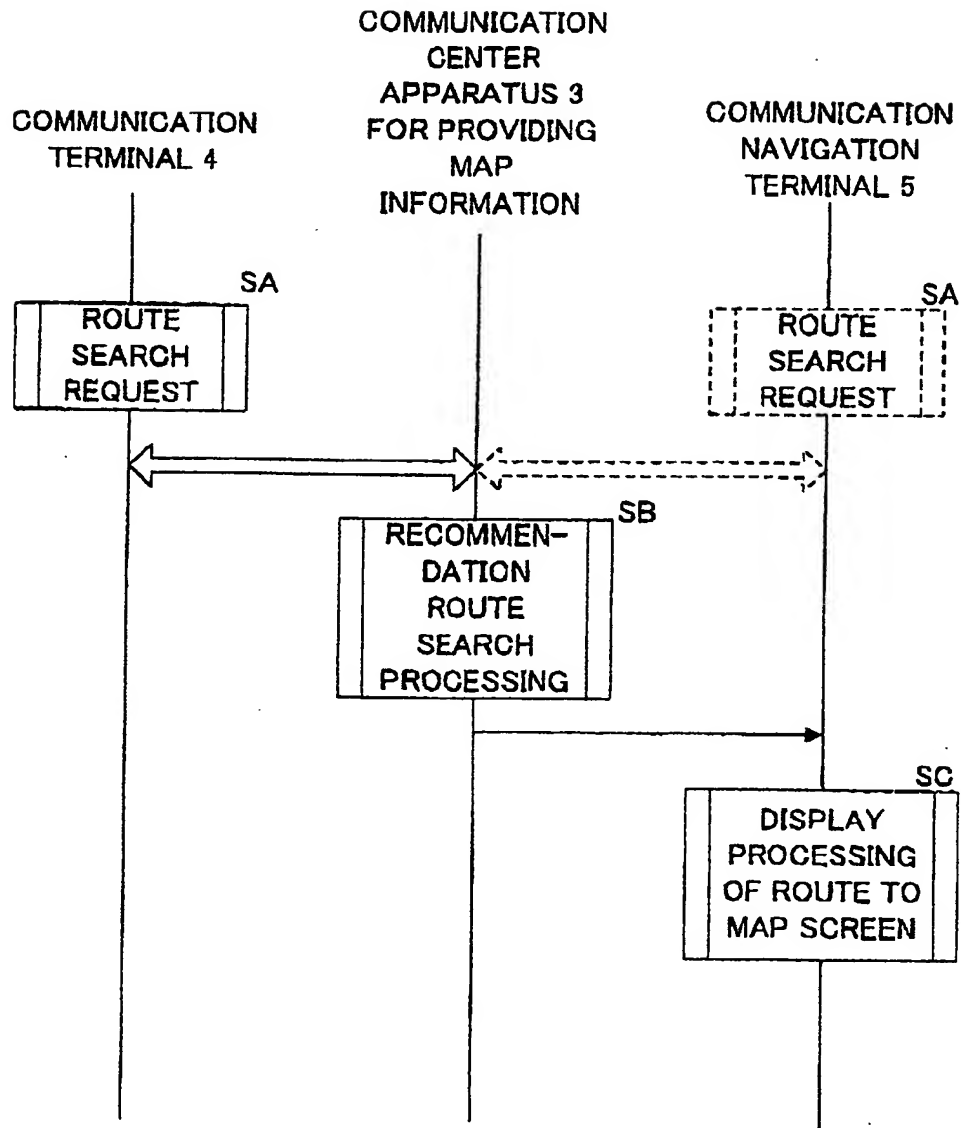


FIG. 4

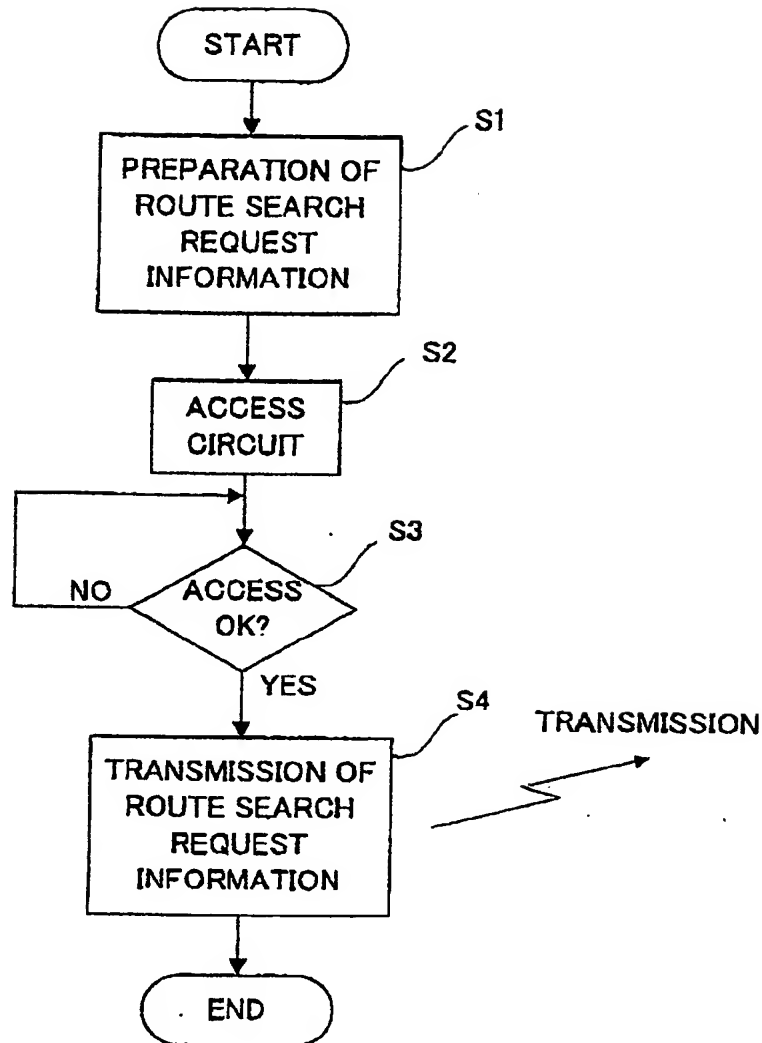


FIG. 5

FIG. 6A

ADDRESS OF ORIGIN

ADDRESS OF DESTINATION

MAGNIFIED  
 MAP OF ORIGIN  
 / DESTINATION

TRANSMISSION TIME

WHERE TO TRANSMIT

FIG. 6B

THROUGHOUT JAPAN HOKKAIDO

PREFECTURE DISTRICT

TRANSMISSION TIME  
☒ NOW ☒ hr min

WHERE TO TRANSMIT

city

partial magnification instruction

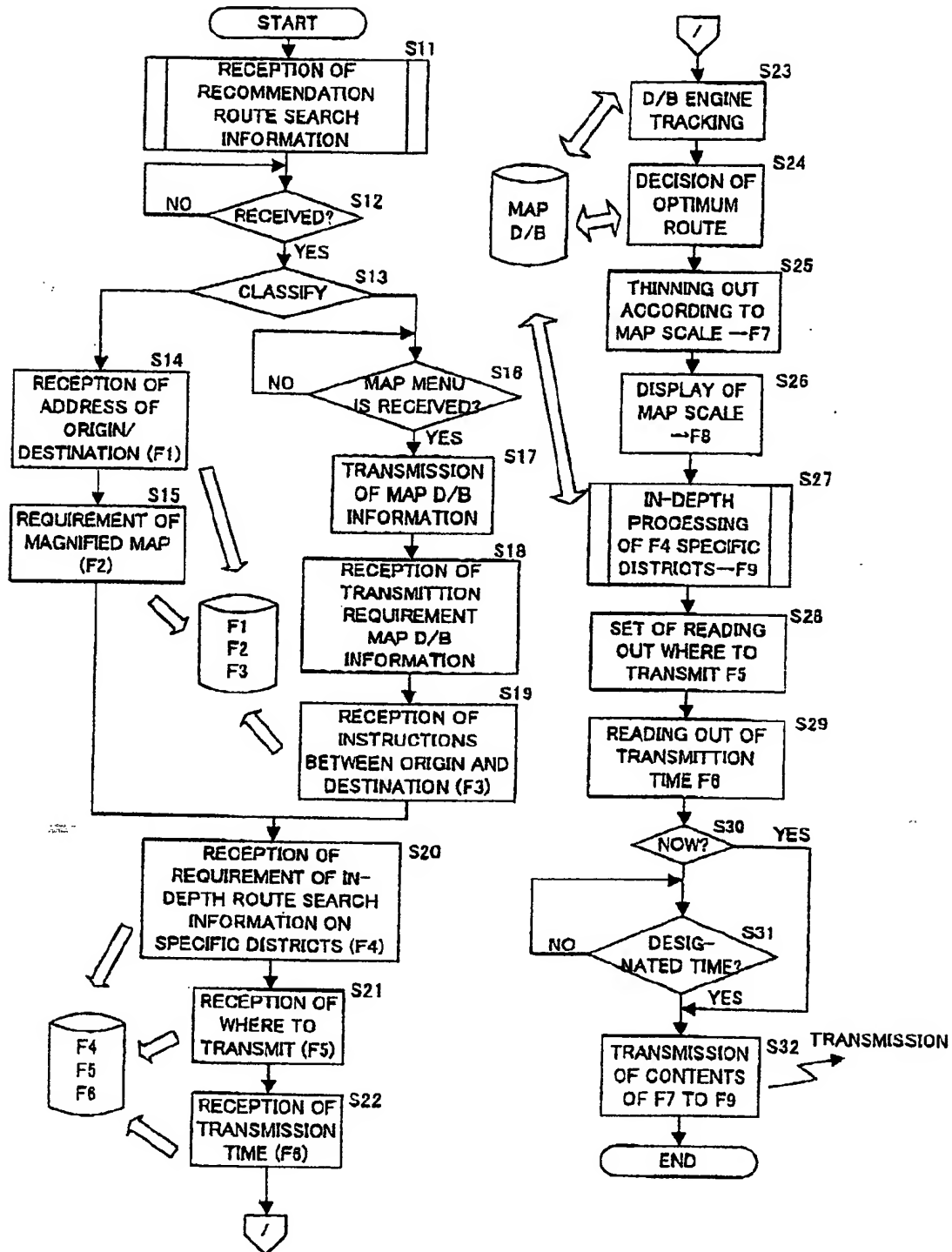
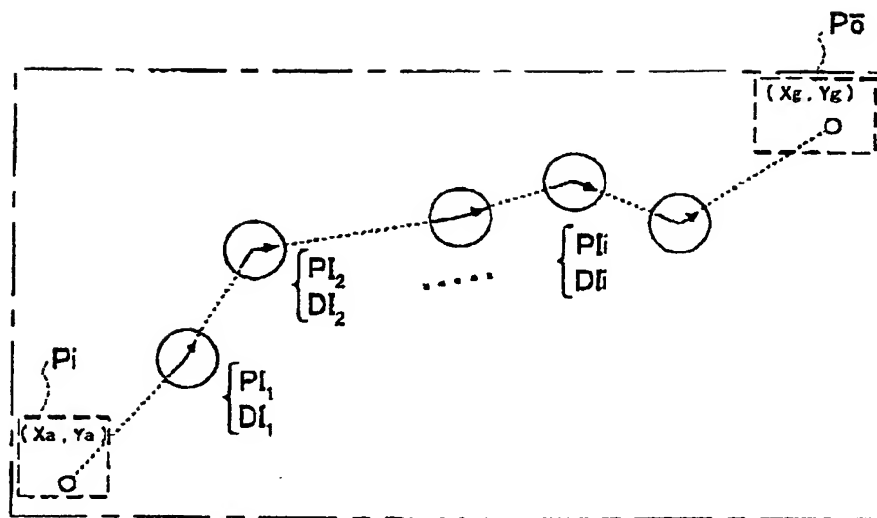


FIG. 7





$P_i = \text{ABSOLUTE COORDINATES } (X_i, Y_i)$   
 or  
 $\text{RELATIVE COORDINATES } (\Delta x_i, \Delta y_i)$   
 $D_i = \text{MOVING DIRECTION CODE}$   
 or  
 $(\text{DIRECT ADVANCE, RIGHT TURN, LEFT TURN, } \dots)$   
 or  
 $\text{AZIMUTH } \alpha$

FIG. 8

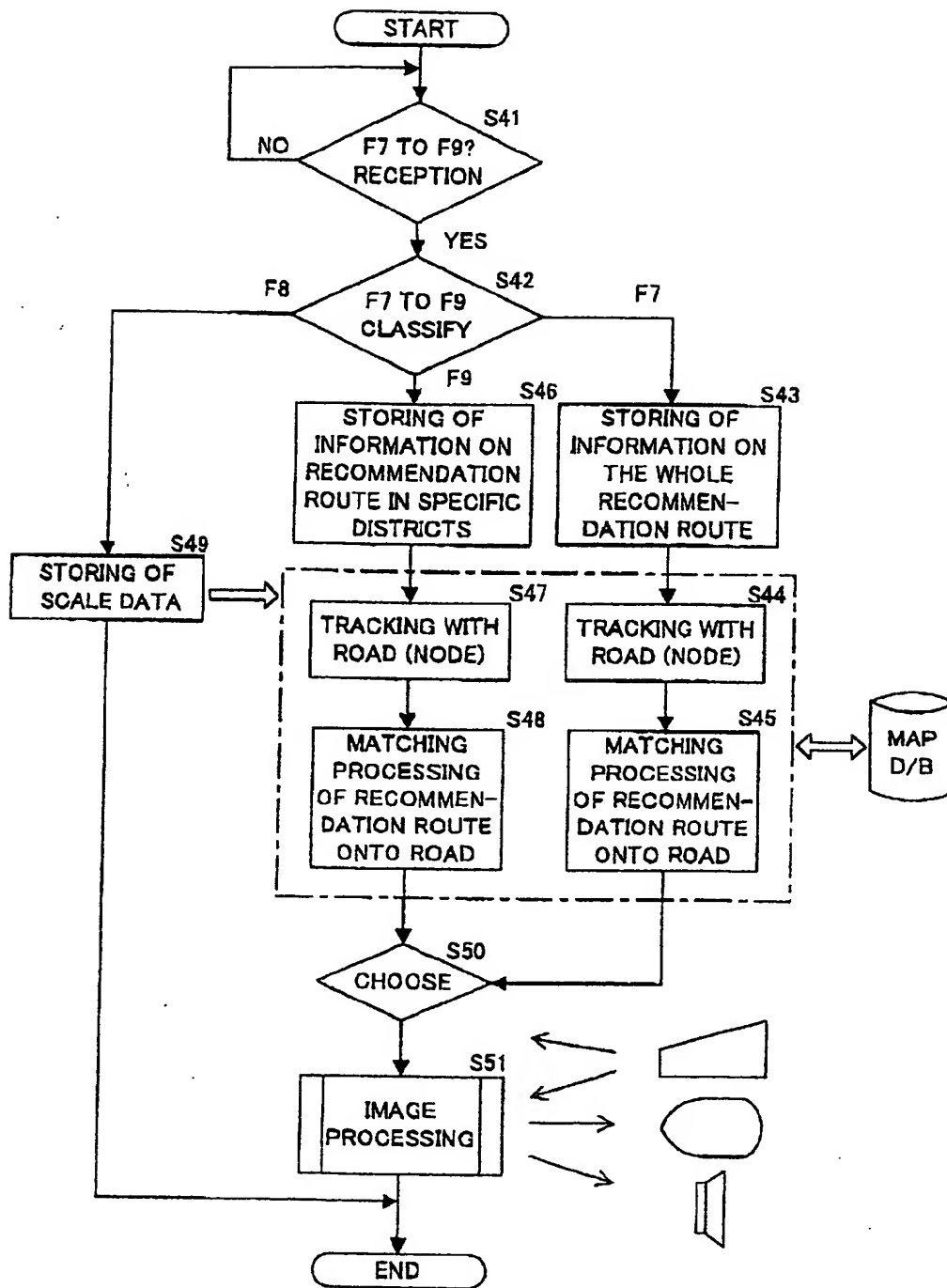


FIG. 9

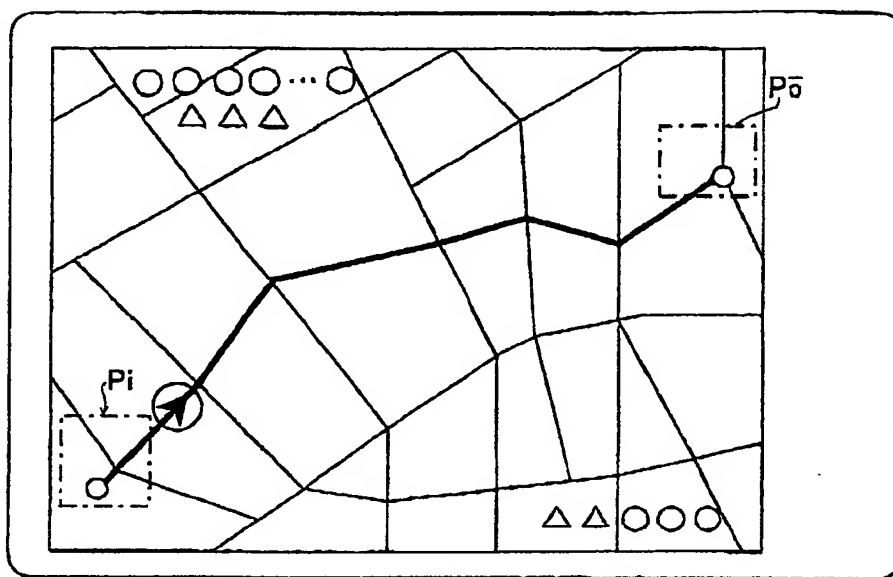


FIG. 10A

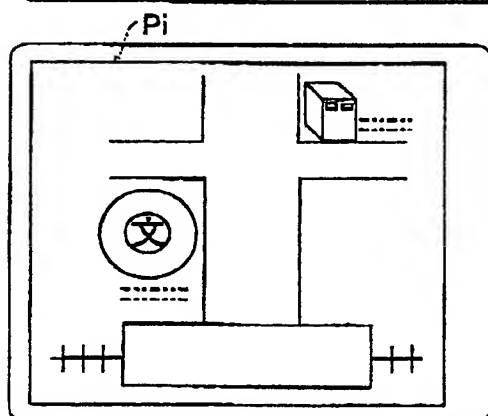
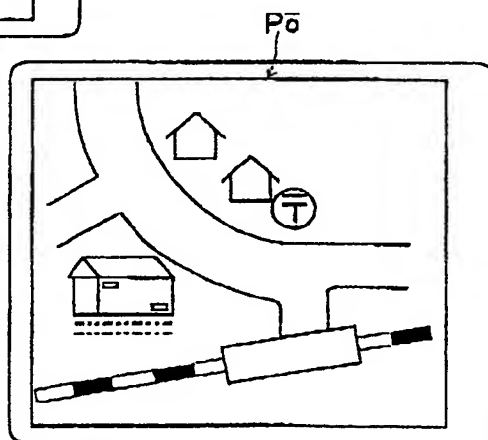


FIG. 10B

FIG. 10C



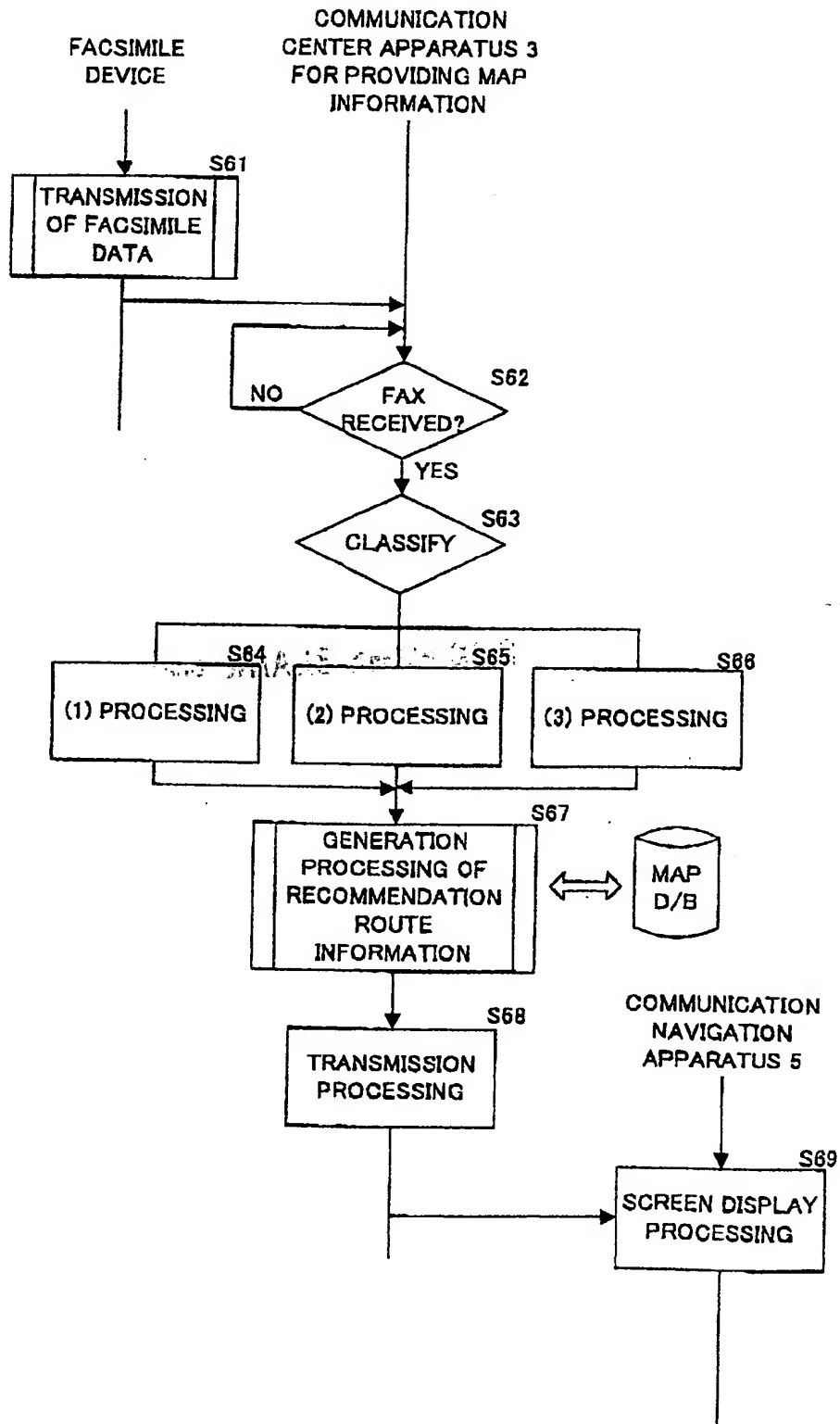


FIG. 11

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